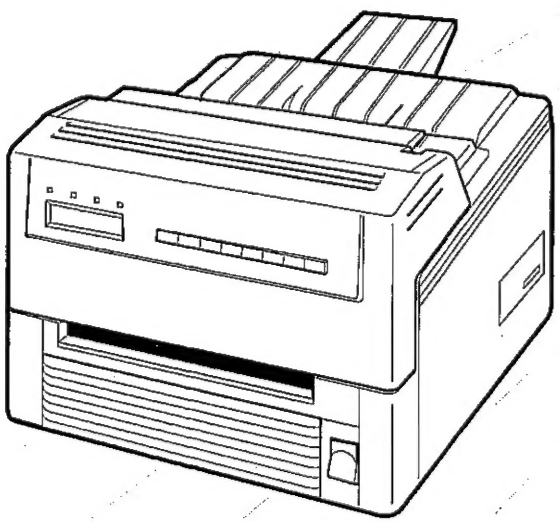
SHARP®

LASER PRINTER

MODEL

JX-9400

PROGRAMMING MANUAL



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INTRODUCTION

This programming manual describes the printer command codes recognized by the Sharp JX-9400 Laser Printer in HP PCL 4 emulation mode, the default mode of the JX-9400.

In addition, this manual lists the printer command codes you can use in the four other emulation modes supported by the JX-9400: Epson FX-80, IBM Proprinter, IBM Graphics Printer, and Diablo 630/630 ECS.

The printer commands described in this manual allow you to include printing instructions as part of the data you send to the printer from your computer. Refer to the documentation provided with your computer software for further information on how to specify these printer command codes.

HP PCL 4 EMULATION

This section describes the printer command codes recognized by the JX-9400 Laser Printer in HP PCL 4 Emulation mode. These codes are of two types: standard ASCII control codes and escape sequences.

Most of the standard ASCII control codes provide a single command to the printer and can be specified with no additional characters or parameters. However, one of these control codes, the ^{E}C code, informs the printer that one or more printing commands follow. Printing commands preceded by the ^{E}C code are called escape sequences. Each emulation mode has its own set of escape sequences. HP PCL 4 escape sequences are described in this section. "ESCAPE SEQUENCES" lists escape sequences for other emulation modes.

CONTROL CODES

HP PCL 4 emulation recognizes the ASCII control codes listed below. You specify these control codes as either decimal or hexadecimal values, depending upon your computer software.

Code: $^{B}_{S}$ (BackSpace)
Function: Moves the print position to the left a distance equal to the width of the last printed symbol or space. If the print position is already at the left margin, no action is taken.

Code: $^{L}_{F}$ (Line Feed)
Function: Moves the print position to the next print line, maintaining the current column position.

Code: $^{F}_{F}$ (Form Feed)
Function: Moves the print position to the first line of the next page, maintaining the current column position.

Code: $^{C}_{R}$ (Carriage Return)
Function: Moves the print position to the left margin of the current line.

Code: $^{S}_{O}$ (Shift Out)
Function: Selects the secondary font, which remains in effect until SI is received.

Code: $^{S}_{I}$ (Shift In)
Function: Selects the primary font, which remains in effect until SO is received.

Code: $^{E}_{C}$ (EsCape)
Function: Introduces a sequence of characters to provide additional printing commands.

Code: $^{H}_{T}$ (Horizontal Tab)
Function: Moves the print position to the next tab stop on the current line. The tab stops are at the left margin and at every eight columns to the right of the left margin.

Code: $^{S}_{P}$ (SPace)
Function: Moves the print position one column to the right.

ESCAPE SEQUENCES

HP PCL 4 escape sequences allow you to specify a wide variety of instructions that control how your data is printed. An escape sequence consists of the $^{E}_{C}$ control code, specified as either a decimal or hexadecimal value, followed by one or more characters, and a value you select in some cases. You can specify escape commands individually or as a series of several commands.

The following types of escape sequences are provided:

Job Control
Line and Page Control
Cursor Control
Character and Font Control
Graphics Control
Macro Control
Other Escape Sequences

Job Control

Job control escape sequences specify special features of the printer:

Sequence: $^{E}_{C}$ z (Interface Self-test)
Function: Instructs the printer to perform an interface self-test. When the printer receives $^{E}_{C}$ z, data processing stops, the current page is printed and the self-test is executed without data loss. If no error is detected the printer remains online and continues its work; if an error is detected the printer goes offline.

Sequence: $^{E}_{C}$ E (Printer Reset)
Function: Instructs the printer to complete the printing of any partial pages of data received before $^{E}_{C}$ E. After completing the printing of partial pages, resets all programmable features to panel default values and deletes temporary fonts and macros. Following the reset, the printer remains online and continues to process data using the default values.

Sequence: $^{E}_{C}$ &ℓ#X (Number of Copies)
Function: Selects the number of copies (# = 1 to 99) of each page to be printed. This command can be inserted anywhere in a page and affects the current page as well as subsequent pages.
Default = 1

Line and Page Control

Line and page control escape sequences control page orientation, page length, margins, line feed, perforation skip, and similar functions.

Sequence: $^{E}_{C}$ &ℓ#H (Paper Handling)
Function: Selects the paper handling method for the printer. Remains in effect until another paper handling command is received by the printer or a paper handling command is changed by key input. When this command is received, the printer starts printing the current page and the cursor moves to the left edge of the logical page at the top margin.

The value field (#) specifies the paper input method, as shown in the following table:

#	Method
0	Prints the current page (Paper source remains unchanged)
1 (default)	paper cassette
2	manual feed
3	envelope manual feed

Sequence: $^{E}_{C}$ &ℓ#A (Page Size)
Function: Selects the page size. The table below shows the page size selection values:

Value (#)	Paper size
2 (default)	Letter (8.5" x 11")
3	Legal (8.5" x 14")
26	A4 (210mm x 297mm)
	ENVELOPES:
80	Monarch 7-3/4 (3-7/8" x 7-1/2")
81	Commercial 10 (4-1/8" x 9-1/2")
90	International DL (110mm x 220mm)
91	International C5 (162mm x 229mm)

Sequence: ^{E}c &ℓ#P (Specify Page Length)
Function: Specifies the physical length of the paper being used as the number of lines (#). Portrait or landscape orientation does not affect the specification. If the orientation is changed, specify the page length first. The tables below show page length values:

Portrait Orientation Page Length Settings

Page size	Lines-per-inch setting	
	6	8
Letter	66	88
Legal	84	112
A4	70	93

Landscape Orientation Page Length Settings

Page size	Lines-per-inch setting	
	6	8
Letter	51	68
Legal*	—*	—*
A4	49	66

* When printing on legal size paper in landscape orientation, set the page length while in portrait orientation (^{E}C & ℓ 84 P) and then specify landscape orientation (^{E}C & ℓ 1O). The lines per page setting is given by multiplying the lines per inch by the length of the page.

If VMI is set to 0, ^{E}C & ℓ # P is ignored.

Sequence: ^{E}c &ℓ#O (Select Page Orientation)
Function: Selects either portrait (# = 0) or landscape (# = 1) page orientation. Portrait orientation prints from left to right across the page in upright position, while landscape prints along the length of the page.
The orientation command sets the page length, top margin, text length, left and right margins, HMI and VMI to their panel default values, and disables the auto overlay macro.

Sequence: ^{E}c &ℓ#E (Specify Top Margin)
Function: Specifies the top margin of the current page as the number of lines (#) to be skipped before printing begins on the page. Top margin values range from 0 to the page length (default is 1/2 inch from the top of the page). Avoid using a top margin value (#) of 0 or 1 because the top two lines are in the unprintable border region.
If VMI is set to 0 or a top margin greater than the page length is specified, ^{E}C &ℓ#E is ignored.

Sequence: $^{E}_{C}$ &ℓ#F (Specify Text Length)
Function: Specifies the number of lines (#) of text to be printed on a page. If a text length value of 0 is specified, the text length is defaulted 1/2 inch from the bottom of the page. If the specified text length minus the bottom margin is greater than the page length, $^{E}_{C}$ &ℓ#F is ignored.

Sequence: $^{E}_{C}$ &a#L (Set Left Margin)
Function: Sets the left margin at a specified column number (#). A left margin value of 0 sets the margin to the leftmost print column (column 0). Column 0 is the default left margin. If the specified left margin exceeds the right margin, $^{E}_{C}$ &a#L is ignored.

Sequence: $^{E}_{C}$ &a#M (Set Right Margin)
Function: Sets the right margin at a specified column number (#). The rightmost print column is the default right margin. If the specified right margin is equal to or less than the left margin, $^{E}_{C}$ &a#M is ignored.

Sequence: $^{E}_{C}$ 9 (Clear Side Margin Settings)
Function: Clears the left and right margin settings. After clearing the left and right margin settings set by $^{E}_{C}$ &a#L and $^{E}_{C}$ &a#M, returns the margins to the default values.
$^{E}_{C}$ 9 followed by $^{C}_{R}$ (carriage return) also returns the cursor to the default left margin.

Sequence: $^{E}_{C}$ &ℓ#L (Perforation Skip Mode)
Function: Enables (# = 1) or disables (# = 0) the perforation skip mode. If perforation skip is enabled ($^{E}_{C}$ &ℓ1L), the printer stops printing at the bottom margin, and then continues printing from the top margin of the next page. When perforation skip is disabled, the bottom margin is disabled. Default = enable.

Note: If you print in the perforation skip area and enter the unprintable border region, data loss will result.

Sequence: $^{E}_{C}$ &k#H (Set Horizontal Motion Index)
Function: When fixed pitch fonts are selected, the HMI affects all printable characters including the space and backspace characters.
When proportional fonts are selected, the HMI affects only the control code space character. The value may range from 0 to 840. The value field is valid to four decimal places.
The table below shows examples of pitch values:

Value (#)	Pitch (cpi)
10	12
12	10

Sequence: ESC &ℓ#C (Set Vertical Motion Index)

Function: Sets the vertical line spacing of printed text in 1/48th inch increments. The value range for # is 0 to 336 and can be specified to four decimal places.

This command affects the line feed and half line feed spacing. The table below shows examples of VMI values:

Value (#)	Line spacing
0 (min)	0 inch (overprint)
6	8 lines per inch
8	6 lines per inch
336 (max)	7 inches

Sequence: ESC &ℓ#D (Set Lines Per Inch)

Function: Sets the vertical line spacing of the printed text in lines per inch. The power on state of the printer is 6 lines per inch. The lines per inch values are shown below:

Value (#)	1, 2, 3, 4, 6, 8, 12, 16, 24, and 48 (lines per inch)

Cursor Control

Cursor control escape sequences control the position of printer's cursor, that is, the currently active printing position.

Sequence: $^{E}_{C}$ &a#C (Horizontal Cursor Control — Columns)
Function: For horizontal positioning of the cursor in increments of the current column pitch (characters per inch) within the print limits of the page. Column values exceeding the print limits of the page will position the cursor at the left or right limits of the current page.
A + or – before the column value (#) moves the cursor relative to the current cursor position (+ to the right; – to the left). A column value without a + or – indicates an absolute distance that is referred from the left edge of the logical page.
The value field is valid to four decimal places.

Sequence: $^{E}_{C}$ &a#H (Horizontal Cursor Control — Decipoints)
Function: For horizontal positioning of the cursor in increments of decipoints (1/720 inch) within the print limits of the page. A + or – before the decipoint value (#) moves the cursor relative to the current cursor position (+ to the right; – to the left). A decipoint value without a + or – indicates an absolute distance that is referred from the left edge of the logical page.
The value field is valid to two decimal points.

Sequence: $^{E}_{C}$ *p#X (Horizontal Cursor Control — Dots)
Function: For horizontal positioning of the cursor in increments of dots (300 dpi) within the print limits of the page. A + or – before the dot value (#) moves the cursor relative to the current cursor position (+ to the right; – to the left). A dot value without + or – indicates an absolute distance that is referred from the left edge of the logical page.

Sequence: $^{E}_{C}$ &a#R (Vertical Cursor Control — Lines)
Function: For vertical positioning of the cursor in increments of the current line pitch (lines per inch) within the print limits of the page. Line values exceeding the print limits of the page will position the cursor at the top of the current page or cause a page eject if the bottom of the page is exceeded.
A + or – before the column value (#) moves the cursor relative to the current cursor position (+ down; – up). A column value without a + or – indicates that the new position is absolute from the top margin.
The value field is valid to four decimal places.
The table below shows examples of line values:

Sequence: $^{E}_{C}$ &a#V (Vertical Cursor Control — Decipoints)
Function: For vertical positioning of the cursor in increments of decipoints (1/720 inch) within the print limits of the page. A + or – before the decipoint value (#) moves the cursor relative to the current cursor position (+ down; – up). A decipoint value without a + or – indicates that the new position is absolute from the top margin.
The value field is valid to two decimal places.

Sequence: $^{E}_{C}$ `*p#Y` (Vertical Cursor Control — Dots)
Function: For vertical positioning of the cursor in increments of dots (300 dpi) within the print limits of the page.
A + or – before the dot value (#) moves the cursor relative to the current cursor position (+ down; – up). A dot value without a + or – indicates that the new position is absolute from the top margin.

Sequence: $^{E}_{C}$ = (Forward Feed One Half Line)
Function: Moves the print position forward one half line. The print position moves forward one half of the current line spacing (defined by the last VMI or line spacing setting.

Sequence: $^{E}_{C}$ `&k#G` (Print Line Termination)
Function: Selects the printer's interpretation of the computer's line termination character. The table below shows the print line termination selection values:

Value (#)	Computer termination	Printer interpretation
0 (default)	C_R	C_R
	L_F	L_F
	F_F	F_F
1	C_R	$C_R + L_F$
	L_F	L_F
	F_F	F_F
2	C_R	C_R
	L_F	$C_R + L_F$
	F_F	$C_R + F_F$
3	C_R	$C_R + L_F$
	L_F	$C_R + L_F$
	F_F	$C_R + F_F$

C_R = Carriage Return L_F = Line Feed F_F = Form Feed

Sequence: $^{E}_{C}$ `&f#S` (Push/pop Position)
Function: Allows the cursor position to be saved (pushed) and recalled (popped) at any time. Up to 20 cursor positions can be stored at one time with the last cursor position pushed (# = 0) being the first position popped (# = 1).
The second cursor position is next in line to be popped, etc.

Example:

$^{E}_{C}$ `&a100h200V`	Sends cursor to position 100, 200.
$^{E}_{C}$ `&f0S`	Pushes the current cursor position.
$^{E}_{C}$ `&a200h300V`	Sends cursor to position 200, 300.
$^{E}_{C}$ `&f0S`	Pushes the current cursor position.
$^{E}_{C}$ `&a400h500V`	Sends cursor to position 400, 200.
$^{E}_{C}$ `&f1S`	Pops the cursor to the last pushed cursor position (200, 300).
$^{E}_{C}$ `&f1S`	Pops the cursor to the next to last pushed cursor position (100, 200).

Character and Font Control

The character and font escape sequence codes control the creation of characters and fonts.

Sequence: $^{E}_{C}$ (## SELECT PRIMARY FONT SYMBOL SET
$^{E}_{C}$)## SELECT SECONDARY FONT SYMBOL SET

Function: Select the primary and secondary font symbol sets. The following table lists examples of symbol sets:

Symbol Set	Primary font escape sequence	Secondary font escape sequence
Math-7	$^{E}_{C}$(0A	$^{E}_{C}$)0A
Line Draw	$^{E}_{C}$(0B	$^{E}_{C}$)0B
ISO 60: Norwegian version 1	$^{E}_{C}$(0D	$^{E}_{C}$)0D
ISO 61: Norwegian version 2	$^{E}_{C}$(1D	$^{E}_{C}$)1D
Roman Extensions	$^{E}_{C}$(0E	$^{E}_{C}$)0E
ISO 4: United Kingdom	$^{E}_{C}$(1E	$^{E}_{C}$)1E
ISO 25: French	$^{E}_{C}$(0F	$^{E}_{C}$)0F
ISO 69: French	$^{E}_{C}$(1F	$^{E}_{C}$)1F
German	$^{E}_{C}$(0G	$^{E}_{C}$)0G
ISO 21: German	$^{E}_{C}$(1G	$^{E}_{C}$)1G
Greek-8	$^{E}_{C}$(8G	$^{E}_{C}$)8G
ISO 15: Italian	$^{E}_{C}$(0I	$^{E}_{C}$)0I
ISO 14: JIS-ASCII	$^{E}_{C}$(0K	$^{E}_{C}$)0K
ISO 57: Chinese	$^{E}_{C}$(2K	$^{E}_{C}$)2K
Technical-7	$^{E}_{C}$(1M	$^{E}_{C}$)1M
Math-8	$^{E}_{C}$(8M	$^{E}_{C}$)8M
ISO 100: ECMA-94 (Latin 1)	$^{E}_{C}$(0N	$^{E}_{C}$)0N
OCRA	$^{E}_{C}$(0O	$^{E}_{C}$)0O
OCRB	$^{E}_{C}$(1O	$^{E}_{C}$)1O
Math-8A	$^{E}_{C}$(0Q	$^{E}_{C}$)0Q
Math-8B	$^{E}_{C}$(1Q	$^{E}_{C}$)1Q
Pi Font A	$^{E}_{C}$(2Q	$^{E}_{C}$)2Q
ECMA-94 (Latin 1) (JX-9C5Z Z Font card)	$^{E}_{C}$(11Q	$^{E}_{C}$)11Q
ISO 11: Swedish	$^{E}_{C}$(0S	$^{E}_{C}$)0S
Spanish	$^{E}_{C}$(1S	$^{E}_{C}$)1S
ISO 17: Spanish	$^{E}_{C}$(2S	$^{E}_{C}$)2S
ISO 10: Swedish	$^{E}_{C}$(3S	$^{E}_{C}$)3S
ISO 16: Portuguese	$^{E}_{C}$(4S	$^{E}_{C}$)4S
ISO 84: Portuguese	$^{E}_{C}$(5S	$^{E}_{C}$)5S
ISO 85: Spanish	$^{E}_{C}$(6S	$^{E}_{C}$)6S
ISO 6: ASCII	$^{E}_{C}$(0U	$^{E}_{C}$)0U
Legal	$^{E}_{C}$(1U	$^{E}_{C}$)1U
ISO 2: Intl Reference Version	$^{E}_{C}$(2U	$^{E}_{C}$)2U
OEM-1	$^{E}_{C}$(7U	$^{E}_{C}$)7U
Roman-8	$^{E}_{C}$(8U	$^{E}_{C}$)8U
PC-8	$^{E}_{C}$(10U	$^{E}_{C}$)10U
PC-8 (D/N)	$^{E}_{C}$(11U	$^{E}_{C}$)11U
PC-850	$^{E}_{C}$(12U	$^{E}_{C}$)12U
Pi Font	$^{E}_{C}$(15U	$^{E}_{C}$)15U

Sequence: ^{E}C (s#P (Select Primary Font Character Spacing)
Function: Selects proportional (# = 1) or fixed (# = 0) character spacing for the primary font. Fixed spacing assigns all characters the same amount of space, while proportional spacing assigns different spacing depending on the characters' horizontal spread (an M receives more space then an I).
The resident default font spacing is fixed.

Sequence: ^{E}C)s#P (Select Secondary Font Character Spacing)
Function: Selects proportional (# = 1) or fixed (# = 0) character spacing for the secondary font. Fixed spacing assigns all characters the same amount of space, while proportional spacing assigns different spacing depending on the characters' horizontal spread (an M receives more space than an I).
The resident default font spacing is fixed.

Sequence: ^{E}C (s#H (Select Primary Font Pitch)
Function: Selects the pitch (characters per inch) to print the primary character font. To print in the specified pitch, a font with the specified pitch must be loaded, or a font with the next smallest pitch will be automatically selected. If a font with a smaller pitch does not exist, then a font with the next largest pitch will be selected.
Font pitch is ignored if proportional spacing is active and available in the requested symbol set.
The factory default primary and secondary pitches are implicitly set by selection of a user default font from the control panel.
The table below shows examples of pitch values:

Value (#)	Pitch (cpi)
10	10
12	12
16.66	16.66

cpi = characters per inch

Sequence: ^{E}C)s#H (Select Secondary Font Pitch)
Function: Selects the pitch (characters per inch) to print the secondary character font. To print in the specified pitch, a font with the specified pitch must be loaded, or a font with the next smallest pitch will be automatically selected. If a font with a smaller pitch does not exist, then a font with the next largest pitch will be selected.
Font pitch is ignored if proportional spacing is active and available in the requested symbol set.
The factory default secondary pitches are 10 cpi.
The previous table (^{E}C (s#H) shows examples of pitch values.

Sequence: $^{E}_{C}$ **(s#V** (Select Primary Font Point Size)
Function: Selects the font size (character height) to print the primary character font. The user default height is implicity set by selection of a user default font issued from the control panel. One point is 1/72 inch.

The table below shows examples of point values:

Value (#)	Point size
10	10
14.4	14.4

Sequence: $^{E}_{C}$ **)s#V** (Select Secondary Font Point Size)
Function: Selects the font size (character height) to print the secondary character font. The factory default height is 12 points.
The previous table ($^{E}_{C}$ (s#V) shows examples of point values.

Sequence: $^{E}_{C}$ **(s#S** (Select Primary Font Character Size)
Function: Selects the character style (upright or italic) to print the primary character font. To print italics, an italic font must be loaded.
The factory default style is upright.
The table below shows the character style values:

Value (#)	Character style
0	upright
1	italic

Sequence: $^{E}_{C}$ **)s#S** (Select Secondary Font Character Style)
Function: Selects the character style (upright or italic) to print the secondary character font. To print italics, an italic font must be loaded.
The factory default style is upright.
The table above ($^{E}_{C}$ (s#S) shows the character style values.

Sequence: $^{E}_{C}$ (s#B (Select Primary Font Thickness)

Function: Selects the character thickness (stroke weight) to print the primary character font. To print a different character thickness, a font with that thickness must be loaded. The user default primary stroke weight is implicitly set by selection of a user default font issued from the control panel.

If the specified stroke weight is greater than or equal to 0 and is not available, the next thicker available stroke weight will be selected.
If no thicker stroke weight is available, the closest available thinner stroke weight will be selected.

If the specified stroke weight is less than zero and is not available, the next thinner available stroke weight will be selected.
If no thinner stroke weight is available, the closest available thicker stroke weight will be selected.

The table below shows the thickness values:

Value(#)	Thickness
–7	Ultra Thin
–5	Thin
–3	Light
0	Medium
+3	Bold
+5	Black
+7	Ultra Black

Sequence: $^{E}_{C}$) s#B (Select Secondary Font Thickness)

Function: Selects the character thickness (stroke weight) to print the secondary character font. To print a different character thickness, a font with that thickness must be loaded.
The factory default primary stroke weight is zero.
The previous table ($^{E}_{C}$ (s#B) shows the thickness values.

Sequence: $^{E}_{C}$ `(s#T` (Select Primary Font Typeface)

Function: Selects the typeface to print the primary character font. To print a different character typeface, a font with that typeface must be loaded. The user default primary font typeface is implicitly set by selection of a user default font issued from the control panel.
The table below shows the typeface values:

Value (#)	Typeface
0	Line printer
3	Courier
4	Helv
5	Tms Rmn
6	Letter Gothic
8	Prestige
11	Presentations
17	Optima *
18	Goramond *
19	Cooper Black *
20	Coronet Bold *
21	Broadway *
22	Bouer Bodoni Black Condensed *
23	Century Schoolbook *
24	University Roman *

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Sequence: $^{E}_{C}$ `)s#T` (Select Secondary Font Typeface)

Function: Selects the typeface to print the secondary character font. To print a different character typeface, a font with that typeface must be loaded. The factory default secondary font typeface is Courier.
The previous table ($^{E}_{C}$ (s#T) shows the typeface values.

Sequence: $^{E}_{C}$ `&k#S` (Select Font Pitch)

Function: Selects either standard pitch (10 characters per inch) or compressed pitch (16.66 characters per inch) to print both primary and secondary character fonts. The table below shows the pitch values:

Value (#)	Pitch (cpi)
0	10
2	16.66

Sequence: ^{E}c (3@ (Primary Font Default)
Function: Selects different font/symbol sets for the primary font with the current page orientation. See the table below for description of the primary font default value functions:

Value (#)	Primary font default function
3	Selects the default font (current page orientation must be maintained) and sets the primary font characteristics to the default font. If the font is proportionally spaced, the pitch (cpi) is not changed.

Sequence: ^{E}c)3@ (Secondary Font Default)
Function: Selects different font/symbol sets for the secondary font in the current page orientation. See the table below for descriptions of the secondary font default value functions:

Value (#)	Secondary font default function
3	Selects the default secondary font (current page orientation must be maintained) and sets the primary font characteristics to the default font. If the font is proportionally spaced, the pitch (cpi) is not changed.

Sequence: ^{E}c &d#D (Select Automatic Underline)
Function: Underlines all following characters until cancelled. All following characters will be underlined until cancelled by ^{E}c &d@ (the next escape sequence). The factory default is underline disabled.

#	
0	Fixed position
3	Floating position

Sequence: ^{E}c &d@ (Cancel Automatic Underline)
Function: Cancels the underline mode set. Use ^{E}c &d#D to cancel the underline mode set.

Sequence: ^{E}c *c#D (Font ID)
Function: Labels a particular font with a number for identification purposes. The number range of the font ID value (#) is 0 to 32767. The printer, however, can store a maximum of 32 fonts at one time.
Default ID is 0.

Sequence: $^{E}_{C}$ *c#F (Character and Font Control)

Function: Specifies the font/character control function to be performed on the font last specified by the $^{E}_{C}$ *c#D (Specify font ID) escape sequence. # specifies the control function.

The table below shows descriptions of the font/character control values:

Value (#)	Font and character control functions
0	Delete all fonts (temporary and permanent)
1	Delete all temporary fonts
2	Delete font (last font ID specified)
3	Delete character code (font ID and character code previously specified)
4	Make font temporary (last font ID specified)
5	Make font permanent (last font ID specified)
6	Copy/assign current font (last font ID specified)

Font/character control functions 2, 4 and 5 must be preceded by a font ID escape sequence.

Note: If any part of the current font is deleted, the page is closed, all pages are printed, and then the font is deleted. If a font is deleted and not used on the current page, all pages (except the current page) are printed, and then the font is deleted.

Sequence: $^{E}_{C}$ (#X (Designate Primary Download Font)

Function: Designates a particular downloaded font as the primary (default) font. The (#) value designates one of up to 32 fonts previously labeled by the font ID escape sequence ($^{E}_{C}$ *c#D).

If the designated font is present and properly oriented, all of its characteristics (except orientation) become those of the primary font.

If the designated font is proportionally spaced, the pitch (cpi) is not changed.

Sequence: $^{E}_{C}$)#X (Designate Secondary Download Font)

Function: Designates a particular downloaded font as the secondary font. The (#) value designates one of up to 32 fonts previously labeled by the font ID escape sequence ($^{E}_{C}$ *c#D).

If the designated font is present and properly oriented, all of its characteristics (except orientation) become those of the secondary font.

If the designated font is proportionally spaced, the pitch (cpi) is not changed.

Sequence: $^{E}_{C}$)s#W (Data Download Font Description)

Function: Creates a font header which describes the characteristics of the font last specified by the font ID. The field value (#) specifies the number of bytes in the font descriptor data field.

If a font with the same font ID exists, the previous font will be deleted from printer memory when the new valid download font escape sequence is received.

If there is not enough memory to create the new font, the new font and the font with the same font ID are deleted.

Byte	15-MSB 8	7 LSB-0
0	Font Descriptor Size	
2	Reserved	Font Type
4	Reserved	
6	Baseline Distance	
8	Cell Width	
10	Cell Height	
12	Orientation	Spacing
14	Symbol Set	
16	Pitch (Default HMI)	
18	Height	
20	xHeight	
22	Width Type	Style
24	Stroke Weight	Typeface
26	Reserved	Serif Style
28	Reserved	
30	Underline Distance	Underline Height
32	Text Height	
34	Text Width	
36	Reserved	
38	Reserved	
40	Pitch Extended	Height Extended
42	Reserved	
44	Reserved	
46	Reserved	
48-63	Font Name	

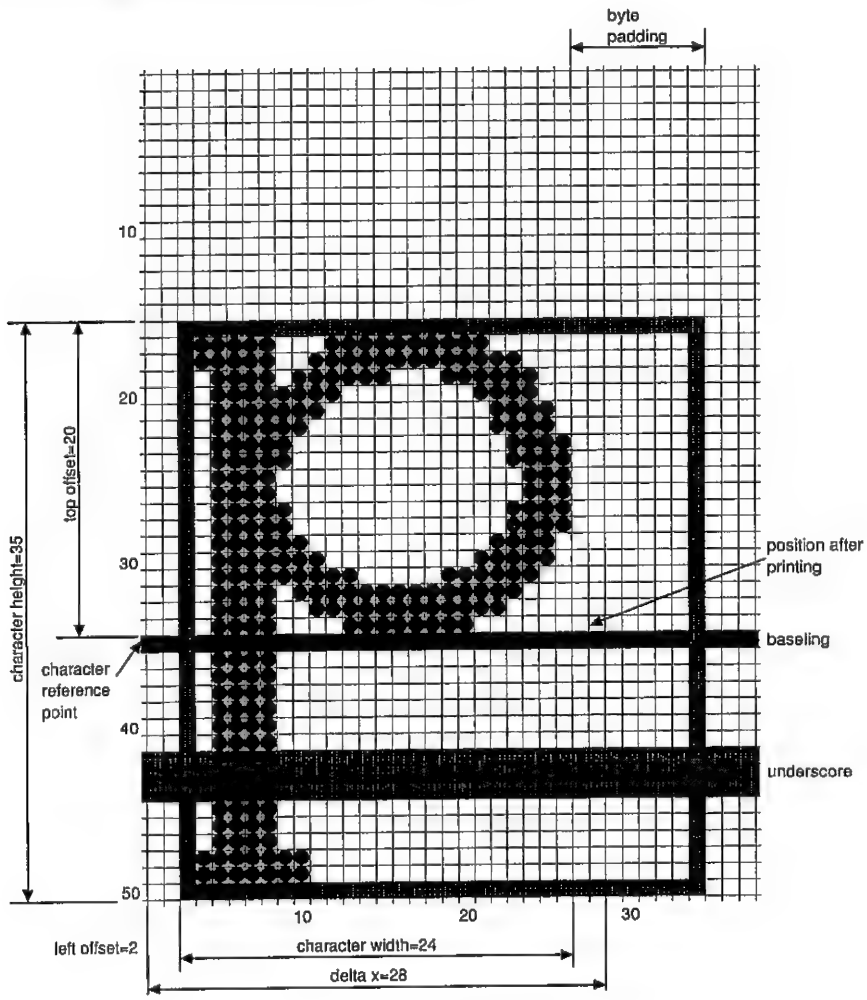
Font descriptor size:

Data byte 0 specifies the number of bytes in the font descriptor. This value is ignored by the JX-9400 printer but should be set to 64.

Font type:
Data byte 3 specifies the font as being 7-bit or 8-bit.

Value	Font type
0	7-bit font (print characters 32-127 decimal)
1	8-bit font (print characters 32-127 and 160-255 decimal)
2	pc-8 (all character codes are printable except 0, 7 to 15, and 27 decimal)

Baseline distance:
Data bytes 6 and 7 specify the distance from the top of the character cell to the baseline in dots. The value is the same for portrait or landscape orientation; see the following figure. The baseline must be contained within the character cell. Therefore the value of the baseline distance falls between 0 and the cell height minus 1.



The character cell
(Portrait orientation)

Cell width:
Data bytes 8 and 9 specify the width of the character cell in dots. The cell width range is 1 to 4200 dots.

Cell height:
Data bytes 10 and 11 specify the height of the character cell in dots. The cell width range is 1 to 4200 dots.

Orientation:
Data byte 12 specifies the orientation of the font.

Value	Orientation
0	portrait
1	landscape

Spacing:
Data byte 13 specifies fixed or proportional character spacing for the font.

Value	Spacing
0	fixed
1	proportional

Symbol set:
Data bytes 14 and 15 select the symbol set to be used for the new font. The number to select the symbol set is calculated by multiplying the number in the symbol set field value by 2, adding to it the decimal ASCII value of the letter, and then subtracting 64 from the total.

Symbol set field value = ROMAN 8 = 8 U = 8 x 32 + (ASCII value for U = 85) – 64 = 256 + 85 – 64 = 277 = Symbol set byte value

The following table lists the symbol sets, their field values and byte values.

Symbol set	Symbol set field value	Symbol set byte value
Math-7	0 A	1
Line Draw	0 B	2
ISO 60: Norwegian version 1	0 D	4
ISO 61: Norwegian version 2	1 D	36
Roman Extensions	0 E	5
ISO 4: United Kingdom	1 E	37
ISO 25: French	0 F	6
ISO 69: French	1 F	38
German	0 G	7
ISO 21: German	1 G	39
Greek-8	8 G	263
ISO 15: Italian	0 I	9
ISO 14: JIS-ASCII	0 K	11
ISO 57: Chinese	2 K	75
Technical-7	1 M	45
Math-8	8 M	269
ISO 100: ECMA-94 (Latin 1)	0 N	14
OCRA	0 O	15
OCRB	1 O	47
ISO 11: Swedish	0 S	19
Spanish	1 S	51
ISO 17: Spanish	2 S	83
ISO 10: Swedish	3 S	115
ISO 16: Portuguese	4 S	147
ISO 84: Portuguese	5 S	179
ISO 85: Spanish	6 S	211
ISO 6: ASCII	0 U	21
Legal	1 U	53
ISO 2: Intl Reference Version	2 U	85
OEM-1	7 U	245
Roman-8	8 U	277
PC-8	10 U	341
PC-8 (D/N)	11 U	373
PC-850	12 U	405
Pi Font	15 U	501

Pitch:
Data bytes 16 and 17 specify the pitch (cpi) of the font characters. The pitch value is calculated by dividing the horizontal resolution of the printer (300 dots per inch) by the desired pitch. The pitch is specified in increments of 1/4 (.25) of a dot and the pitch value can range from 0 to 16800. A value exceeding 16800 will be set to 16800.

Height:
Data bytes 18 and 19 specify the height of the font characters. The height value is calculated by multiplying the desired height (in dots) by 4. The height can be specified to 1/4 (.25) of a dot. The height value can range from 0 to 10922. A value exceeding 10922 will be set to 10922.

xHeight:
Specifies the height of the lower case "x" in quarter-dot units.
This is ignored by the JX-9400 printer.

Width type:
Specifies the proportionate width of characters in the font.
This is ignored by the JX-9400 printer.

Style:
Data byte 23 specifies upright or italic font characters.

Value	Style
0	upright
1	italic

Stroke weight:
Data byte 24 specifies the thickness of the strokes used in the font. The thickness value may vary from -7 to 7.

Value	Thickness
–7	maximum light
–3	light
0	normal (medium)
3	heavy (bold)
7	maximum heavy (bold)

Typeface:
Data byte 25 specifies the typeface of the fonts.

Value (#)	Typeface
0	Line printer
3	Courier
4	Helv
5	Tms Rmn
6	Letter Gothic
7	Script
8	Prestige
9	Caslon *
10	Orator *
11	Presentations
17	Optima *
18	Goramond *
19	Cooper Black *
20	Coronet Bold *
21	Broadway *
22	Bauer Bodoni Black Condensed *
23	Century Schoolbook *
24	University Roman *

* Registered trademarks of a third party

Underline distance:
Data byte 30 specifies the distance from the baseline to the top dot row of the underline in dots. A positive value specifies an underline position above the baseline. A negative value specifies an underline position below the baseline.

Underline height:
Data byte 31 specifies the thickness of the underline in dots.
The JX-9400 always prints 3 dot thick underlines.

Text height:
Specifies the font's optimum inter-line spacing in quarter-dot units. This is ignored by the JX-9400 printer.

Text width:
Specifies the font's optimum character spacing in quarter-dot units. This is ignored by the JX-9400 printer.

Pitch extended:
Data byte 40 specifies Pitch Extended value. This is an addition to the Pitch field which extends the pitch an extra eight bits. The value of this field is in 1024ths of one dot. For example, a 17 pitch font would have a Pitch field of 70 (17.5 dots, or 17.1429 cpi) and a Pitch Extended field of 150 (0.1465 dots additional, which gives 17.6465 dots, or 17.0005 cpi).

Height extended:
Data byte 41 specifies Height Extended value. This is an additional to the Height field which extends the height an extra eight bits. The value field is in 1024ths of one dot. For example, a 10 point font would have a Height field of 166 (41.5 dots, or 9.96 points) and a Height Extended field of 170 (0.1660 dots additional, which gives 9.9998 points).

Font name:
This is a 16-character ASCII field to which the user may assign a font name. The JX-9400 printer prints this font name on the Font Sample Printout.

Sequence: $^{E}_{C}$ `(s#W[DATA]` (Download Character Descriptor)

Function: Downloads a character to the printer. The downloaded character is assigned the character code last specified and is added to the font specified by the font ID escape sequence ($^{E}_{C}$ *c#D).
If an existing character has the same character code as the download character, the existing character is deleted from printer memory and the new character is downloaded.
If there is not enough memory for the download character, the font will be deleted.
The field value (#) specifies the number of bytes in the character descriptor/data field.
The table below shows the character descriptor data values:

Byte	15-MSB 8	7 LSB-0
0	format (4)	continuation
2	description size	class
4	orientation	always 0
6	left offset	
8	top offset	
10	character width	
12	character height	
14	delta X	
16	character data (in bytes) . . .	

Format:
Specifies the format of the character descriptor and data. The format number used by the JX-9400 is 4.

Continuation:
Specifies whether the following data is a character descriptor block (0) or a continuation of the data (1) associated with the previous character descriptor.
Because the escape sequence value field is limited to 32767, characters whose number of descriptor and data block bytes would exceed this limit must be downloaded in two or more blocks. The following illustrates the format of a character data continuation block.

Byte	15-MSB 8	7 LSB-0
0	format	continuation (1)
2	character data: . . .	

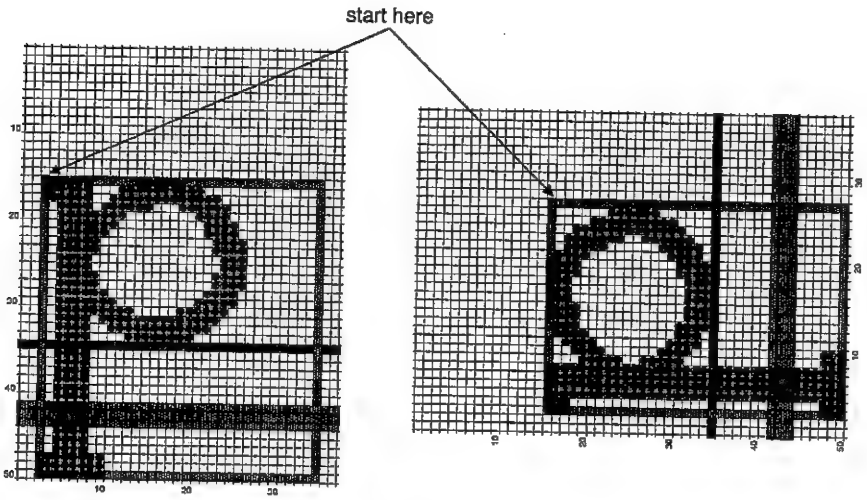
Descriptor size:
Specifies the size of the character descriptor in bytes. The descriptor size used by the JX-9400 is 14.

Class:
Specifies the format of the character data. The character data format number used by the JX-9400 is 1.

Orientation:
Data byte 4 specifies the orientation of the font.

Value	Orientation
0	portrait
1	landscape

Left offset:
Data bytes 6 and 7 specify the distance from the reference point to the left side of the character pattern in dots. The value is relative to the physical page, so the value is different for portrait or landscape orientation, see the figure below. The range of left offset values is –4200 to 4200.



The character cell
(portrait and landscape orientation)

Top offset:
Data bytes 8 and 9 specify the distance from the reference point to the top of the character pattern in dots. The value is relative to the page orientation, so the value is different for portrait or landscape orientation, see the figure above. The range of top offset values is –4200 to 4200.

Character width:
Data bytes 10 and 11 specify the width of the character in dots. The character width value is relative to the page orientation, so the value is different for portrait or landscape orientation, see the figure above. The range of character width values is 1 to 4200.

Character height:
Data bytes 12 and 13 specify the height of the character in dots. The character height value is relative to the page orientation, so the value is different for portrait or landscape orientation, see the figure above. The range of character height value is 1 to 4200.

Delta X:
Data bytes 14 and 15 are used to specify the horizontal (X) distance the cursor will travel after printing a specified proportionally spaced character. Delta X is specified as the desired number of dots multiplied by 4. For example, if the desired character spacing is 5 dots, the delta X value would be 20 (5 x 4 = 20). The range of delta X is 0 to 16800.

Character data:
Data bytes from 16 are the raw data used to represent the character. The character data is composed of a string of bytes that define the character. The bytes are defined in rows of bytes describing the character width. Each row of bytes is made up of binary data (0's and 1's). This binary data describes the dots and spaces (1's and 0's) the printer will receive, process, and print. The total number of character data equals the character width in bytes multiplied by the character height in dots.

Sequence: $^{E}_{C}$ `*c#E` (Character Code)
Function: Specifies the decimal ASCII value of a character to be downloaded. The character code value (#) can be a number from 0 to 255 which corresponds to an 8-bit ASCII character.

Graphics Control

Graphics control escape sequences control the resolution, start, transfer, and end of custom raster graphics development. Advanced escape sequence codes control the printing of rules, patterns and gray scales.

Sequence: $^{E}_{C}$ `*t#R` (Raster Graphics Resolution)
Function: Sets the raster resolution (#) of the graphics to be printed. The default setting for graphics resolution is 75 dpi.
If the optional 1 MB expansion memory is installed, up to a full page of graphics can be printed at 300 dpi.
The table below lists the maximum graphics image size using the four available resolutions.

Resolution (#)	Maximum raster image
75	full page (Letter or A4)
100	full page (Letter or A4)
150	full page (Letter or A4)
300	full page (Letter or A4)

Sequence: $^{E}_{C}$ `*r#A` (Start Raster Graphics)
Function: Notifies the printer that graphics data will follow and specifies the page position where the graphics printing will start. If # = 0, graphics will be started at the leftmost print position (not the left margin) on the page.
If # = 1, graphics will be started at the current cursor position, the cursor may be positioned before sending this command.
When printing graphics with landscape orientation, the left graphics margin becomes the top of the page margin.

Sequence: $^{E}_{C}$ ***b#W** (Transfer Raster Graphics)
Function: Specifies the number of binary graphics data bytes (#) to be sent to the printer for processing. The bytes of data are translated to bits of raster graphics data and sent to the printer one line (dot row) at a time.
$^{E}_{C}$ *b#W must be sent to the printer for each line of graphics data.

Sequence: $^{E}_{C}$ ***rB** (End Raster Graphics)
Function: Informs the printer that all raster graphics data has been transferred to the printer and sets the printer to accept text data.

Example:

Print a raster graphic image.

1. Specify the cursor location:
   $^{E}_{C}$***p300x400Y** Specifies the point (300, 400) in the escape sequences.
2. Specify the resolution:
   $^{E}_{C}$***t75R** Sets the raster graphics resolution to 75 dots per inch.
3. Specify the start of raster graphics:
   $^{E}_{C}$***r1A** Specifies the start of graphics printing at the current position.
4. Transfer the raster graphics data:
   $^{E}_{C}$***b#W** Send the image data one line at a time.
5. Signal the end of raster graphics data:
   $^{E}_{C}$***rB**

Sequence: $^{E}_{C}$ ***c#A** (Horizontal Rectangle Size — Dots)
Function: Specifies the length of a horizontal rectangle in dots (300 dpi). The default the horizontal rectangle size is 0.
Values greater than the page size are accepted, but are printed within the printable area boundaries.

Example: Specify a horizontal rectangle of 5 inches.
Input the escape sequence $^{E}_{C}$ *c1500A (5 x 300 = 1500).

Sequence: $^{E}_{C}$ ***c#H** (Horizontal Rectangle Size — Decipoints)
Function: Specifies the length of a horizontal rectangle in decipoints (1/720th inch). The default the horizontal rectangle size is 0.
Values greater than the page size are accepted, but are printed within the printable area boundaries.

Example: Specify a horizontal rectangle of 5 inches.
Input the escape sequence $^{E}_{C}$ *c3600H (5 x 720 = 3600).

The value field is valid to four decimal places.

Sequence: $^{E}_{C}$ *c#B (Vertical Rectangle Size — Dots)
Function: Specifies the length of a vertical rectangle in dots (300 dpi). The default the vertical rectangle size is 0.
Values greater than the page size are accepted, but are printed within the printable area boundaries.

Example: Specify a vertical rectangle of 5 inches.
Input the escape sequence $^{E}_{C}$ *c1500B (5 x 300 = 1500).

Sequence: $^{E}_{C}$ *c#V (Vertical Rectangle Size — Decipoints)
Function: Specifies the length of a vertical rectangle in decipoints (1/720th inch). The default the vertical rectangle size is 0.
Values greater than the page size are accepted, but are printed within the printable area boundaries.

Example: Specify a vertical rectangle of 5 inches.
Input the escape sequence $^{E}_{C}$ *c3600V (5 x 720 = 3600).

Sequence: $^{E}_{C}$ *c#P (Print Rule/pattern)
Function: Selects if a rule, a defined pattern, or a gray scale pattern is to be printed. It then commands the printer to start printing. When $^{E}_{C}$ *c#P is received, the area defined by the horizontal and vertical rule/pattern escape sequences is filled with the specified pattern.
If a specified pattern or gray scale pattern is selected, the printer will print the pattern defined by the last pattern ID received.
The table below shows the print value selections:

Value (#)	Print selection
0	black rule
2	gray scale pattern
3	defined pattern

Sequence: $^{E}_{C}$ *c#G (Pattern ID)
Function: Selects 1 of 8 gray scale patterns or 1 of 6 defined patterns when used with the print rule ($^{E}_{C}$ *c#P) escape sequence. Out of range pattern ID values are ignored.
The table below shows the pattern ID value selections for defined pattern and gray scale pattern printing.

Pattern ID values

Value (#)	Defined pattern
1	horizontal lines
2	vertical lines
3	+45 deg. lines
4	–45 deg. lines
5	grid
6	45 deg. grid

Value (#)	Gray scale pattern
1 to 2	2% gray
3 to 10	10% gray
11 to 20	15% gray
21 to 35	30% gray
36 to 55	45% gray
56 to 80	70% gray
81 to 99	90% gray
100	100% gray (Black)

Example:
Print a 3 inch by 5 inch black area.

1. Specify the cursor location:
   `ESC*p 300x400Y` Specifies the point (300, 400) in the PCL coordinate system.
2. Specify the width of the area:
   `ESC*c900A` Sets the width to 900 dots (3 inches).
3. Specify the height of the area:
   `ESC*c1500B` Sets the height to 1500 dots (5 inches).
4. Print the solid filled area:
   `ESC*c0P`

Macro Control

Macro control escape sequences control the creation and use of macros. A macro is an escape sequence which combines other escape sequences to perform a task. The macro can be stored and then recalled to perform the same task again. The printer can store up to 32 macros at a time.

Sequence: `ESC &f#Y` (Specify Macro ID)
Function: Assigns an ID Number (#) to a macro. If you wish to store (download) or execute (retrieve) the macro, you must first use this escape sequence to name or refer to the macro. Up to 32 macros (# = 0 to 32767) can be numbered at one time.
Default = 0

Sequence: `ESC &f#X` (Define Macro Control)
Function: Specifies the macro control to be performed using the macro control values (# = 0 to 10). The table below shows the macro control values:

Value (#)	Macro control function
0*	start macro definition
1	stop macro definition
2*	execute macro
3*	call macro
4*	enable auto macro overlay
5	disable auto macro overlay
6	delete all macros
7	delete all temporary macros
8*	delete macro
9*	make macro temporary
10*	make macro permanent

* Must be preceded by a macro ID escape sequence.

Value	Description
0	$^{E}_{C}$ &f0X, start macro definition, creates a temporary macro identified by the macro ID preceding it. All data is read and stored until $^{E}_{C}$ &f1X (stop macro definition) or a reset is received.
1	$^{E}_{C}$ &f1X, stop macro definition, indicates the end of the macro data.
2	$^{E}_{C}$ &f2X, execute macro, identified by the macro ID in the current environment. When the macro has been executed, any escape sequences modified in the current environment by the macro are retained, however, the cursor position remains unchanged. See the table below for a listing of current environment escape sequences:

Current environment escape sequences	
Page length	Primary font address
Page orientation	Font ID
Input control	Character code
Copy count	Macro ID
Margins	VMI/line spacing
Top	Horizontal rule spacing
Left	Vertical rule size
Right	Underline mode
Perforation skip	Graphics resolution
Line termination	Graphics mode
EOL (wrap) termination	Graphics left margin
Font attributes	Pattern ID
HMI	

3	$^{E}_{C}$ &f3X, call macro, executes the macro identified by the macro ID in the current environment. After the macro has executed, any escape sequences modified in the current environment by the macro are deleted, and the current environment reverts to its previous values. However, the cursor position remains unchanged. See the table above for a listing of current environment escape sequence.
4	$^{E}_{C}$ &f4X, enable auto macro overlay, defines the macro identified by the macro ID for use as the auto macro overlay, replacing any previous auto macro overlay. If $^{E}_{C}$ &f4X is received, every page printed is executed using the overlay environment and overlay default values. After the macro has executed, the previous current environment is restored, replacing the overlay environment. The following tables show a listing of current overlay environment escape sequences:

Overlay environment escape sequences	
Overlay	Page length
Page orientation	Copy count
Position stack	

Overlay default values	
Top margin (1/2 in)	Font ID (0)
Bottom margin (1/2 in)	Character code (0)
Left margin (far left)	Macro ID (0)
Right margin (far right)	Current active position
Perf skip mode (enabled)	(Leftmost & top margin)
Line termination (0)	VMI/line spacing (6 lpi)
EOL wrap (off)	Horiz. rule size (0)
Font attributes (default)	Vert. rule size (0)
HMI (default)	Underline mode (off)
Primary font (default)	Graphics resolution (75 dpi)
Secondary font (default)	Graphics mode (off)
	Pattern ID (0)

5 $^{E}_{C}$ &f5X, disable auto macro overlay, exits the auto macro overlay function at the current page. Changing the page length or orientation disables the auto macro overlay after $^{E}_{C}$ &f5X is executed.

6 $^{E}_{C}$ &f6X delete all macros (temporary, permanent and auto macro overlays) that may have been in effect.

7 $^{E}_{C}$ &f7X delete all temporary macros (including auto macro overlays) that may have been in effect.

8 $^{E}_{C}$ &f8X delete macro last specified by the macro ID escape sequence ($^{E}_{C}$ &f#Y).

9 $^{E}_{C}$ &f9X, make macro temporary, designates the macro last specified by the macro ID escape sequence ($^{E}_{C}$ &f#Y) to be a temporary macro.

10 $^{E}_{C}$ &f10X, make macro permanent, designates the macro last specified by the macro ID escape sequence ($^{E}_{C}$ &f#y) to be a permanent macro.

Example: Define a mcro with ID 7:
Send: $^{E}_{C}$&f7y0X

escape sequences, control codes, and data to be used when the macro is called

$^{E}_{C}$&f1X
Make the macro with ID 7 permanent:
Send: $^{E}_{C}$&f7y10X
Implement the macro with ID 7 for automatic overlay:
Send: $^{E}_{C}$&f7y4X
Delete the macro with ID 7:
Send: $^{E}_{C}$&f7y8X

Sequence: $^{E}_{C}$ Y (Select Display Functions Mode)
Function: Disables all control codes and escape sequences and allows them to be printed as blanks (spaces). There are two exceptions to these escape sequences: carriage return ($^{C}_{R}$) is executed as a carriage return ($^{C}_{R}$) + line feed ($^{L}_{F}$), and $^{E}_{C}$ Z is executed and printed as a blank followed by a Z.

Sequence: $^{E}_{C}$ Z (Cancel Display Functions Mode)
Function: Cancels $^{E}_{C}$ Y and allows all valid control codes and escape sequences to be executed after it is received. $^{E}_{C}$ Z is the power-on state of the printer.

Sequence: $^{E}_{C}$ &p#X [DATA] (Select Transparent Print Date)
Function: Sets the printer to process data without processing any control codes or escape sequences that may be included.
The value field (#) specifies the number of bytes of data to be processed in this manner. Print data should follow immediately.

Example: Print a square bullet using the HP PCL 4 PC-8 Character Set.
Send the sequence:
$^{E}_{C}$ & p 1 X (21)

Sequence: $^{E}_{C}$ &s#C (Line Wrap)
Function: Enables and disables line wrap. If enabled, the printer executes a $^{C}_{R}$ + $^{L}_{F}$ if all (or part) of a character falls outside the right margin.
The table below shows the line wrap selection values:

Value (#)	Line wrap
0	enabled
1	disabled (default)

This table lists the HP PCL 4 emulation escape sequences, along with the page in this manual where each escape sequence is described.

■ HP PCL 4 Emulation Escape Sequences

Function	Sequence	Command	Page
JOB CONTROL			
Interface self-test		$^{E}_{C}$ z	3
Printer reset		$^{E}_{C}$ E	3
Number of copies		$^{E}_{C}$ &ℓ #X	3
LINE and PAGE CONTROL			
Paper handling	Current page unchanged	$^{E}_{C}$ &ℓ 0H	4
	Paper cassette	$^{E}_{C}$ &ℓ 1H	4
	Manual feed	$^{E}_{C}$ &ℓ 2H	4
	Envelope manual feed	$^{E}_{C}$ &ℓ 3H	4
PAGE LENGTH and SIZE			
Page size	Letter	$^{E}_{C}$ &ℓ 2A	4
	Legal	$^{E}_{C}$ &ℓ 3A	4
	A4	$^{E}_{C}$ &ℓ 26A	4
	Monarch	$^{E}_{C}$ &ℓ 80A	4
	Commercial 10 (Business)	$^{E}_{C}$ &ℓ 81A	4
	International DL	$^{E}_{C}$ &ℓ 90A	4
	International C5	$^{E}_{C}$ &ℓ 91A	4
Page length	Number of lines	$^{E}_{C}$ &ℓ #P	5
Page orientation	Portrait	$^{E}_{C}$ &ℓ 0O	5
	Landscape	$^{E}_{C}$ &ℓ 1O	5
MARGINS and TEXT LENGTH			
Top margin	Number of lines	$^{E}_{C}$ &ℓ #E	5
Text length	Number of lines	$^{E}_{C}$ &ℓ #F	6
Left margin	Left (column number)	$^{E}_{C}$ &a#L	6
Right margin	Right (column number)	$^{E}_{C}$ &a#M	6
Clear side margin settings		$^{E}_{C}$ 9	6
PERFORATION SKIP MODE			
Perforation skip	Disable	$^{E}_{C}$ &ℓ 0L	6
	Enable	$^{E}_{C}$ &ℓ 1L	6
HORIZONTAL COLUMN SPACING			
Horizontal motion index	Number of 1/120" increments	$^{E}_{C}$ &k#H	6

■ HP PCL 4 Emulation Escape Sequences (cont.)

Function	Sequence	Command	Page
VERTICAL LINE SPACING			
Set vertical motion index	Number of 1/48" increments	E_C &ℓ #C	7
Set lines per inch	1 line/inch	E_C &ℓ 1D	7
	2 lines/inch	E_C &ℓ 2D	7
	3 lines/inch	E_C &ℓ 3D	7
	4 lines/inch	E_C &ℓ 4D	7
	6 lines/inch	E_C &ℓ 6D	7
	8 lines/inch	E_C &ℓ 8D	7
	12 lines/inch	E_C &ℓ 12D	7
	16 lines/inch	E_C &ℓ 16D	7
	24 lines/inch	E_C &ℓ 24D	7
	48 lines/inch	E_C &ℓ 48D	7
CURSOR CONTROL			
HORIZONTAL and VERTICAL			
Horizontal	Column	E_C &a#C	8
	Dots	E_C *p#X	8
	Decipoints	E_C &a#H	8
Vertical	Lines	E_C &a#R	8
	Dots	E_C *p#Y	9
	Decipoints	E_C &a#V	8
Half line feed		E_C =	9
LINE TERMINATION			
Print line termination	C_R=C_R L_F=L_F F_F=F_F	E_C &k0G	9
	C_R=C_R+L_F L_F=L_F F_F=F_F	E_C &k1G	9
	C_R=C_R L_F=C_R+L_F F_F=C_R+F_F	E_C &k2G	9
	C_R=C_R+L_F L_F=C_R+L_F F_F=C_R+F_F	E_C &k3G	9
PUSH/POP POSITION			
Push/pop position	Push	E_C &f0S	9
	Pop	E_C &f1S	9
CHARACTER and FONT CONTROL			
SYMBOL SET SELECTION			
Primary font symbol set	Math7	E_C (0A	10
	Line Draw	E_C (0B	10
	ISO 60: Norwegian Version 1	E_C (0D	10
	ISO 61: Norwegian Version	E_C (1D	10
	Roman Extension	E_C (0E	10
	ISO 4: United Kingdom	E_C (1E	10
	ISO 25: French	E_C (0F	10
	ISO 69: French	E_C (1F	10
	German	E_C (0G	10
	ISO 21: German	E_C (1G	10
	Greek8	E_C (8G	10
	ISO 15: Italian	E_C (0I	10
	ISO 14: JIS ASCII	E_C (0K	10
	ISO 57: Chinese	E_C (2K	10
	Technical-7	E_C (1M	10
	Math-8	E_C (8M	10
	ISO 100: ECMA-94 (Latin 1)	E_C (0N	10

■ HP PCL 4 Emulation Escape Sequences (cont.)

Function	Sequence	Command	Page
Secondary font symbol set	OCR A	E_C (0O	10
	OCR B	E_C (1O	10
	Math-8A	E_C (0Q	10
	Math-8B	E_C (1Q	10
	Pi Font A	E_C (2Q	10
	ECMA-94 (Latin 1) (JX-9C5Z Z Font card)	E_C (11Q	10
	ISO 11: Swedish	E_C (0S	10
	Spanish	E_C (1S	10
	ISO 17: Spanish	E_C (2S	10
	ISO 10: Swedish	E_C (3S	10
	ISO 16: Portuguese	E_C (4S	10
	ISO 84: Portuguese	E_C (5S	10
	ISO 85: Spanish	E_C (6S	10
	ISO 6: ASCII	E_C (0U	10
	Legal	E_C (1U	10
	ISO 2: Intl Reference Version	E_C (2U	10
	OEM-1	E_C (7U	10
	Roman-8	E_U (8U	10
	PC-8	E_C (10U	10
	PC-8 (D/N)	E_C (11U	10
	PC-850	E_C (12U	10
	Pi Font	E_C (15U	10
		E_C)##	10
SPACING			
Primary font character spacing	Proportional	E_C (s1P	11
	Fixed	E_C (s0P	11
Secondary font character spacing	Proportional	E_C)s1P	11
	Fixed	E_C)s0P	11
PITCH			
Primary font pitch		E_C (s#H	11
Secondary font pitch		E_C)s#H	11
POINT SIZE			
Primary font point size		E_C (s#V	12
Secondary font point size		E_C)s#V	12
STYLE			
Primary font style	Upright	E_C (s0S	12
	Italic	E_C (s1S	12
Secondary font style	Upright	E_C)s0S	12
	Italic	E_C)s1S	12
CHARACTER THICKNESS			
Primary font thickness	Ultra thin	E_C (s-7B	13
	Thin	E_C (s-5B	13
	Light	E_C (s-3B	13
	Medium	E_C (s0B	13
	Bold	E_C (s+3B	13
	Black	E_C (s+5B	13
	Ultra black	E_C (s+7B	13
Secondary font thickness		E_C)s#B	13

■ HP PCL 4 Emulation Escape Sequences (cont.)

Function	Sequence	Command	Page
TYPEFACE			
Primary font typeface	Line Printer	E_C (s0T	14
	Courier	E_C (s3T	14
	Helv	E_C (s4T	14
	Tms Rmn	E_C (s5T	14
	Letter Gothic	E_C (s6T	14
	Prestige	E_C (s8T	14
	Presentations	E_C (s11T	14
	Optima	E_C (s17T	14
	Garamond	E_C (s18T	14
	Cooper Black	E_C (s19T	14
	Coronet Bold	E_C (s20T	14
	Broadway	E_C (s21T	14
	Bauer Bodoni Black Condensed	E_C (s22T	14
	Century Schoolbook	E_C (s23T	14
	University Roman	E_C (s24T	14
Secondary font typeface		E_C)s#T	14
FONT PITCH			
Primary & secondary Font pitch	10.00 pitch	E_C &k0S	14
(Alternate method)	16.66 pitch	E_C &k2S	14
Font default	Primary font	E_C (3@	15
	Secondary font	E_C)3@	15
UNDERLINE			
Automatic underline	Fixed position	E_C &d0D	15
	Floating position	E_C &d3D	15
	Cancel	E_C &d@	15
FONT MANAGEMENT			
Font ID	Font ID number	E_C *c#D	15
Character and font control	Delete all fonts	E_C *c0F	16
	Delete all temporary fonts	E_C *c1F	16
	Delete font	E_C *c2F	16
	Delete character code	E_C *c3F	16
	Make font temporary	E_C *c4F	16
	Make font permanent	E_C *c5F	16
	Copy/assign current font	E_C *c6F	16
FONT SELECTION BY ID NUMBER			
Designate download fonts	Primary font	E_C (#X	16
	Secondary font	E_C)#X	16
SOFT FONT CREATION			
Download font description	Number of bytes	E_C)s#W DATA~	17
Download character descriptor	Number of bytes	E_C(s#W DATA~	23
Character code	Decimal ASCII	E_C *c#E	26

■ HP PCL 4 Emulation Escape Sequences (cont.)

Function	Sequence	Command	Page
GRAPHICS CONTROL			
RASTER GRAPHICS			
Resolution	75 dots per inch	$_{E}$C *t75R	26
	100 dots per inch	$_{E}$C *t100R	26
	150 dots per inch	$_{E}$C *t150R	26
	300 dots per inch	$_{E}$C *t300R	26
Start raster graphics	Left graphics margin	$_{E}$C *r0A	26
	Current cursor	$_{E}$C *r1A	26
Transfer raster graphics	Number of rows	$_{E}$C *b#W DATA	27
End raster graphics		$_{E}$C *rB	27
RECTANGLE DIMENSIONS			
Rectangle width (Horizontal size)	Number of dots	$_{E}$C *c#A	27
	Number of decipoints	$_{E}$C *c#H	27
Rectangle height (Vertical size)	Number of dots	$_{E}$C *c#B	28
	Number of decipoints	$_{E}$C *c#V	28
RECTANGULAR AREA FILL			
Print rule/pattern	Black rule	$_{E}$C *c0P	28
	Gray scale pattern	$_{E}$C *c2P	28
	Defined pattern	$_{E}$C *c3P	28
Defined pattern	Horizontal line	$_{E}$C *c1G	28
	Vertical lines	$_{E}$C *c2G	28
	+45 deg. lines	$_{E}$C *c3G	28
	–45 deg. lines	$_{E}$C *c4G	28
	Grid	$_{E}$C *c5G	28
	45 deg. grid	$_{E}$C *c6G	28
Gray scale pattern	2% gray	$_{E}$C *c2G	28
	10% gray	$_{E}$C *c10G	28
	15% gray	$_{E}$C *c15G	28
	30% gray	$_{E}$C *c30G	28
	45% gray	$_{E}$C *c45G	28
	70% gray	$_{E}$C *c70G	28
	90% gray	$_{E}$C *c90G	28
	100% gray	$_{E}$C *c100G	28
MACRO CONTROL			
MACRO ID and CONTROL			
Macro ID	Macro ID number	$_{E}$C &f#Y	29
Define macro control	Start macro definition	$_{E}$C &f0X	29
	Stop macro definition	$_{E}$C &f1X	29
	Execute macro	$_{E}$C &f2X	29
	Call macro	$_{E}$C &f3X	29
	Enable auto macro overlay	$_{E}$C &f4X	29
	Disable auto macro overlay	$_{E}$C &f5X	29
	Delete all macros	$_{E}$C &f6X	29
	Delete all temp. macros	$_{E}$C &f7X	29
	Delete all macro	$_{E}$C &f8X	29
	Make macro temporary	$_{E}$C &f9X	29
	Make macro permanent	$_{E}$C &f10X	29
OTHER ESCAPE SEQUENCES			
Select display functions		$_{E}$C Y	32
Cancel display functions		$_{E}$C Z	32
Transparent print data	Number of bytes	$_{E}$C &p#X [DATA]	32
Line wrap	Enabled	$_{E}$C &s0C	32
	Disabled (default)	$_{E}$C &s1C	32

OTHER EMULATIONS

This section lists the printer command codes recognized by the JX-9400 Laser Printer in Epson FX-80, IBM Proprinter, IBM Graphics Printer, and Diablo 630/630 ECS emulation modes.

The embedded format precedes and follows the commands by two forward slashes:

//(command)//

In order for embedded commands to be recognized as valid commands and not printable data, the line containing the embedded command(s) must begin with a $^{C}_{R}$ control code, contain no other printable characters (control codes such as $^{S}_{P}$ between commands are allowed), and end with a $^{C}_{R}$ control code. It is permissible to begin and end the line with $^{C}_{R}$ $^{L}_{F}$ pairs but the $^{L}_{s}$ (line feeds) will be executed.

If the command is not a valid command or does not conform to the embedded format, the characters will be treated as normal printable data and be printed. If the command is valid but cannot be acted on (such as a command to select the envelope feeder when the envelope feeder is not installed) the command will be ignored but not printed.

The individual sections describing the embedded format versions of the commands may show spaces between the characters of the command. These are only for clarity and are not part of the command.

Note:
The embedded commands are not supported by all the escape commands.

All Emulation Commands

Function	Command	Remarks
All Emulation Change	$^{E}_{C}$~$^{E}_{C}$~ *n*A	*n*=1 DEFAULT EMULATION
		n=2 FX-80
		n=3 D630
		n=4 HPLJII (Laser Jet series II (PCL 4))
		n=5 IBM PP
		n=6 IBM GP

n: number

The commands available in Epson FX-80 emulation mode are listed below.

■ Epson FX-80 Command Codes

Function	Command	Remarks
Bell	$^{B}_{L}$	Beep
Backspace	$^{B}_{S}$	
Cancel	$^{C}_{N}$	
Horizontal Tab	$^{H}_{T}$	The maximum HTAB position is subject to current paper width.
Line Feed	$^{L}_{F}$	
Vertical Tab	$^{V}_{T}$	If a request is made for a location outside the printer's logical page, the current page is ejected.
Carriage Return	$^{C}_{R}$	
Form Feed	$^{F}_{F}$	
Condensed Mode ON	$^{S}_{I}$	Characters are printed at 17.1 CPI (137 characters on one 8-inch line).
Enlarged Mode ON with Auto-reset	$^{S}_{O}$	Characters are printed in double width.
Printer Select	$^{D}_{1}$	
Condensed Mode OFF	$^{D}_{2}$	
Deselect Printer	$^{D}_{3}$	
Enlarged Mode OFF	$^{D}_{4}$	
Delete	$^{D}_{L}$	Last character
Enlarged Mode ON	$^{E}_{C}$ $^{S}_{O}$	Same as $^{S}_{O}$.
Condensed Mode ON	$^{E}_{C}$ $^{S}_{I}$	Same as $^{S}_{I}$.
1/8" LF Pitch	$^{E}_{C}$ 0	
7/72" LF Pitch	$^{E}_{C}$ 1	
1/6" LF Pitch	$^{E}_{C}$ 2	
n/216" LF Pitch	$^{E}_{C}$ 3 *a*	($0 \leq a \leq 255$)
Italic (Alternate) Mode ON	$^{E}_{C}$ 4	Italic font is selected.
Italic (Alternate) Mode OFF	$^{E}_{C}$ 5	Normal font is selected.
Print Code Area Expand	$^{E}_{C}$ 6	80_H to $9F_H$ are accepted as character set.
Print Code Area Expand Cancel	$^{E}_{C}$ 7	$^{E}_{C}$ 6 setting cancel.

a: ASCII character; *n*: number

■ Epson FX-80 Command Codes (cont.)

Function	Command	Remarks
Paper Out Detection Disable	ESC 8	This command is ignored.
Paper Out Detection Enable	ESC 9	This command is ignored.
Print Mode Select	ESC ! *a*	($0 \leq a \leq 63$) See "Mixed Print Mode", page 55.
Underline Print Mode ON/OFF	ESC – *n* (minus)	*n*=1, 49 ON *n*=0, 48 OFF
VFU Channel Select	ESC / *a*	($0 \leq a \leq 7$)
Home Head (Printing from left mast to right for 1 line)	ESC <	This command is ignored since it has no print head mechanism.
MSB 0 Set	ESC =	
MSB 1 Set	ESC >	
MSB Control Sequence Cancel	ESC #	
Printer Initialize	ESC @	Print buffer is cleared. All printer status is initialized as the printer is turned ON.
Line Space Setting	ESC A *a*	*a*/72" LF Pitch Setting. ($0 \leq a \leq 85$)
Vertical Tab Set	ESC B *a1 a2* ... *ak* 0	($1 \leq ak \leq$ current form length) ($1 \leq k \leq 16$)
Form Length Setting by Number of Lines	ESC C *a*	Form length=line spacing x *a*. ($1 \leq a \leq 127$) If a request is made for a specified position outside the printer's logical page, the position is specified to the appropriate logical page limit.
Form Length Setting in Inches	ESC C 0 *a*	($1 \leq a \leq 22$) If a request is made for a specified position outside the printer's logical page, the position is specified to the appropriate logical page limit.
Horizontal Tab Set	ESC D *a1 a2* ... *ak* 0	($1 \leq ak \leq$ margin length) ($1 \leq k \leq 32$) When the specified HTAB position crosses the current paper width, the data is ignored. The maximum tab number is 256.
Emphasized Mode Setting	ESC E	Double printing at 2-dot spacing.
Emphasized Mode Cancel	ESC F	
Double Strike Mode Setting	ESC G	Double printing at 1-dot spacing.
Double Strike Mode Cancel	ESC H	

a: ASCII character; *n*: number

■ Epson FX-80 Command Codes (cont.)

Function	Command	Remarks
Control Code Select	$^{E}_{C}$ I *n*	Undefined codes in the range 00_H to $1F_H$ and 80_H to $9F_H$ are assigned as character code. *n*=0, 48 Control code *n*=1, 49 Printable character See "International Character Table", page 56.
n/216" Line Feed	$^{E}_{C}$ J *a*	0 ≤ *a* ≤ 255
8-pin Normal Density Bit Image	$^{E}_{C}$ K *a1 a2*	Data per a line = *a2* x 256 + *a1* bit Prints about 2/5 pages without expansion memory.
8-pin Dual Density Bit Image	$^{E}_{C}$ L *a1 a2*	Same as above.
Elite Size Mode	$^{E}_{C}$ M	12 CPI
Perforation Line Skip ON	$^{E}_{C}$ N *n*	This command is ignored.
Perforation Line Skip OFF	$^{E}_{C}$ O	This command is ignored.
Cancel Elite Size Mode	$^{E}_{C}$ P	10 CPI
Right Margin Set	$^{E}_{C}$ Q *a*	n: depends on print mode. Left margin + 2 ≤ *a* ≤ 80 Pica mode Left margin + 3 ≤ *a* ≤ 96 Elite mode Left margin + 4 ≤ *a* ≤ 137 Condensed mode
National Character Select	$^{E}_{C}$ R *a*	(0 ≤ *a* ≤ 10) See "International Character Set", page 64.
Super/Subscript Mode ON	$^{E}_{C}$ S *n*	*n*=0, 48 Superscript *n*=1, 49 Subscript
Super/Subscript Mode OFF	$^{E}_{C}$ T	
One-way Print ON/OFF	$^{E}_{C}$ U *n*	This command is ignored.
Enlarged Mode ON/OFF	$^{E}_{C}$ W *n*	*n*=1, 49 ON *n*=0, 48 OFF
Double-Speed Double-Sensity Bit Image	$^{E}_{C}$ Y *n1 n2*	Prints about 2/5 pages without expansion memory.
Quadruple Density Bit Image	$^{E}_{C}$ Z *n1 n2*	Prints about 2/5 pages without expansion memory.
VFU Position Set	$^{E}_{C}$ b *a m1* ... *mk* 0	(0 ≤ *a* ≤ 7) (1 ≤ *k* ≤ 16)
Incremental & View Function	$^{E}_{C}$ i *n*	This command is ignored.
n/216" Backward Line Feed	$^{E}_{C}$ j *a*	(0 ≤ *a* ≤ 255) If a request is made for a location outside the printer's logical page, the current cursor position is moved to the appropriate logical page limit.

a: ASCII character; *n*: number

■ Epson FX-80 Command Codes (cont.)

Function	Command	Remarks
Left Margin Set	$^{E}_{C}$ l *a*	0 ≤ *a* ≤ right margin – 2 Pica mode 0 ≤ *a* ≤ right margin – 3 Elite mode 0 ≤ *a* ≤ right margin – 4 Condensed mode
Propertional Spacing Mode ON/OFF	$^{E}_{C}$ p *n*	*n*=1, 49 ON *n*=0, 48 OFF
Half-Speed ON	$^{E}_{C}$ s *n*	This command is ignored since print head speed is irrelevant.
8-pin Bit Image Mode	$^{E}_{C}$ * *m a1 a2*	*m* 0 60 dots/inch 1 120 dots/inch 2 120 dots/inch 3 240 dots/inch 4 80 dots/inch 5 72 dots/inch 6 90 dots/inch 7 144 dots/inch Prints about 2/5 pages without expansion memory.
9-pin Bit Image Mode	$^{E}_{C}$ ^ *n a1 a2*	*n*=0 Normal density *n*=1 Dual density Prints about 2/5 pages without expansion memory.
Down Load	$^{E}_{C}$ & *n*	This command is ignored.
ROM CG Copy	$^{E}_{C}$: 0 0 0	This command is ignored.
Down Load Character Select	$^{E}_{C}$ % 1 0	This command is ignored.
ROM CG Selection	$^{E}_{C}$ % 0 0	This command is ignored.
Paper Source	$^{E}_{C}$ $^{E}_{M}$ *n*	*n*=1 TRAY *n*=M MANUAL *n*=R EJECT THE CURRENT PAGE
Paper Size	$^{E}_{C}$ d*n*	*n*=B LEGAL *n*=D LETTER *n*=H A4 *n*=R COMMERCIAL 10 *n*=S INTERNATIONAL DL *n*=U INTERNATIONAL C5 *n*=M MONARCH 7 3/4
Orientation	$^{E}_{C}$ VP $^{E}_{C}$ VL	PORTRAIT LANDSCAPE

a: ASCII character; *n*: number

■ Epson FX-80 Command Codes (cont.)

Function	Command	Remarks
Change Bit Image Mode	$^{E}_{C}?^{n}n^{u}$ *a*	*n*=K,L,Y,Z (0 ≤ *a* ≤ 7)
Paper Source	//*n*//	*n*=1 TRAY *n*=M MANUAL *n*=R EJECT THE CURRENT PAGE
Paper Size	//d *n*//	*n*=B LEGAL *n*=D LETTER *n*=H A4 *n*=R COMMERCIAL 10 *n*=S INTERNATIONAL DL *n*=U INTERNATIONAL C5 *n*=M MONARCH 7 3/4
Orientation	//P// //L//	PORTRAIT LANDSCAPE

a: ASCII character; *n*: number

The printable character set for the Epson FX-80 emulation ranges from 20_H to FF_H, within which standard ASCII characters are from 20_H to $7F_H$, and italic characters are from $A0_H$ to FF_H.

The commands available in IBM Proprinter emulation mode are listed below.

Note that the ^{E}C 6 code allows access to IBM Proprinter Character Set 2. The ^{E}C 7 code returns back to IBM Proprinter Character Set 1.

■ IBM Proprinter Command Codes

Function	Command	Remarks
Cancel	^{C}N	
Condensed Mode ON	^{S}I	17.1 CPI (137 characters on one 8-inch line).
Enlarged ON	^{S}O	by line
Carriage Return	^{C}R	
Printer Select	$^{D}1$	
Condensed Mode OFF	$^{D}2$	10 CPI
Printer Deselect	$^{D}3$	
Page End	^{F}F	
Enlarged OFF	$^{D}4$	
Vertical TAB	^{V}T	
Line Feed	^{L}F	
Horizontal TAB	^{H}T	
Backspace	^{B}S	
Bell	^{B}L	Beep command
Null	^{N}L	
Underline Print Mode ON/OFF	$^{E}C - n$ (minus)	n=1, 49 ON n=0, 48 OFF
Overscore Print Mode ON/OFF	$^{E}C\_n$ (underline)	n=1, 49 ON n=0, 48 OFF
1/8" LF Pitch Set	^{E}C 0	
7/72" LF Pitch Set	^{E}C 1	
Start Variable Line Feed	^{E}C 2	Execution Command for ^{E}C A
n/216" LF Pitch Set	^{E}C 3 a	($1 \leq a \leq 255$)
Set Top of Form	^{E}C 4	When this command is received, the page is ended. Data after ^{E}C4 is printed from the top of the next page.
Automatic Line Feed	^{E}C 5 n	n=1 ^{C}R, ^{L}F n=0 ^{C}R only
Select Character Set 2	^{E}C 6	
Select Character Set 1	^{E}C 7	
Elite Pitch Mode	^{E}C :	$^{D}2$ resets to 10 CPI.

a: ASCII character; n: number

■ IBM Proprinter Command Codes (cont.)

Function	Command	Remarks
Print Continuously from All Characters Chart	$^{E}_{C}$ \ *a1a2*	(1 ≤ *a* ≤ 255)
Print Single Character from All Characters Chart	$^{E}_{C}$ ^ *a*	
n/72" LF Pitch Set	$^{E}_{C}$ A *a*	(1 ≤ *a* ≤ 85)
Vertical Tab Set	$^{E}_{C}$ B*a1a2* ... *a64*,0	Max. 64 positions.
Page Length Set in Lines	$^{E}_{C}$ C *a*	Form length=Line spacing x *n* 6 LPI (1 ≤ *a* ≤ 255)
Page Length Set in Inches	$^{E}_{C}$ C0 *a*	(1 ≤ *a* ≤ 14) If a request is made for a specified position outside the printer's logical page, the position is specified to the appropriate logical page limit.
Horizontal Tab Set	$^{E}_{C}$ D*a1a2* ... *a28*,0	When the specified HTAB position crosses the current paper width, the data is ignored. The maximum tab number is 256.
Emphasized ON	$^{E}_{C}$ E	Double printing at 2 dots spacing.
Emphasized OFF	$^{E}_{C}$ F	
Double Strike ON	$^{E}_{C}$ G	Double printing at 1 dots spacing.
Double Strike OFF	$^{E}_{C}$ H	
Print Mode Select	$^{E}_{C}$ I *n*	*n*=0, Standard font, Normal print *n*=2, Standard font, Double strike print.
n/216" Line Feed	$^{E}_{C}$ J *a*	(1 ≤ *a* ≤ 255)
480 Bit-Image Graphics Mode	$^{E}_{C}$ K*a1a2*	Data per a line is max. 480 bit. Prints about 2/5 pages without expansion memory.
960 Bit-Image Graphics Mode	$^{E}_{C}$ L*a1a2*	Prints about 2/5 pages without expansion memory. Data per a line is max. 960 bit.
Set Skip Perforation	$^{E}_{C}$ N *n*	This command is ignored.
Cancel Skip Perforation	$^{E}_{C}$ O	This command is ignored.
Deselect IBM Proprinter	$^{E}_{C}$ Q (3)	
Set All Tabs to Power On Settings	$^{E}_{C}$ R	
Super/Subscript Mode ON	$^{E}_{C}$ S *n*	*n*=0, 48 Superscript *n*=1, 49 Subscript
Super/Subscript Mode OFF	$^{E}_{C}$ T	
Unidirectional Printing	$^{E}_{C}$ U *n*	This command is ignored.
Enlarged ON/OFF	$^{E}_{C}$ W *n*	*n*=1, 49 Enlarged ON *n*=0, 48 Enlarged OFF

a: ASCII character; *n*: number

■ IBM Proprinter Command Codes (cont.)

Function	Command	Remarks
960 Bit-Image Graphics Mode Normal Speed	$^{E}_{C}$ Y*a1a2*	Prints about 2/5 pages without expansion memory. Data per a line is max. 960 bit.
1920 Bit-Image Graphics Mode	$^{E}_{C}$ Z*a1a2*	Prints about 2/5 pages without expansion memory. Data per a line is 1,920 bit.
Download	$^{E}_{C}$ =	This command is ignored.
Paper Source	$^{E}_{C}$ $^{E}_{M}$ *n*	*n*=1 TRAY *n*=M MANUAL *n*=R EJECT THE CURRENT PAGE
Paper Size	$^{E}_{C}$ d *n*	*n*=B LEGAL *n*=D LETTER *n*=H A4 *n*=R COMMERCIAL 10 *n*=S INTERNATIONAL DL *n*=U INTERNATIONAL C5 *n*=M MONARCH 7 3/4
Orientation	$^{E}_{C}$ VP $^{E}_{C}$ VL	PORTRAIT LANDSCAPE
Paper Source	//*n*//	*n*=1 TRAY *n*=M MANUAL *n*=R EJECT THE CURRENT PAGE
Paper Size	//d *n*//	*n*=B LEGAL *n*=D LETTER *n*=H A4 *n*=R COMMERCIAL 10 *n*=S INTERNATIONAL DL *n*=U INTERNATIONAL C5 *n*=M MONARCH 7 3/4
Orientation	//P// //L//	PORTRAIT LANDSCAPE

a: ASCII character; *n*: number

The commands available in IBM Graphics Printer emulation mode are listed below.

Note that the $^{E}_{C}$ 6 code allows access to IBM Graphics Printer Character Set 2. The $^{E}_{C}$ 7 code returns back to IBM Graphics Printer Character Set 1.

■ IBM Graphic Printer Command Codes

Function	Command	Remarks
Cancel	$^{C}_{N}$	Clears the printer buffer. Control codes, except $^{S}_{O}$ remain in effect.
Condensed Mode ON	$^{S}_{I}$	17.1 CPI (137 characters on one 8-inch line).
Double Width ON	$^{S}_{O}$	
Carriage Return	$^{C}_{R}$	
Condensed Mode OFF	$^{D}_{2}$	
Page End	$^{F}_{F}$	
Enlarged OFF	$^{D}_{4}$	
Vertical Tab	$^{V}_{T}$	$^{V}_{T}$ code treated as a $^{L}_{F}$.
Line Feed	$^{L}_{F}$	
Horizontal Tab	$^{H}_{T}$	
Bell	$^{B}_{L}$	Beep Comand
Underline Print Mode ON/OFF	$^{E}_{C} - n$ (minus)	n=1, 49 Underline mode ON n=0, 48 Underline mode OFF
1/8" LF Pitch Set	$^{E}_{C}$ 0	
7/72" LF Pitch Set	$^{E}_{C}$ 1	
Start Variable Line Feed	$^{E}_{C}$ 2	Execution Command for $^{E}_{C}$ A
n/216" LF Pitch Set	$^{E}_{C}$ 3 a	($1 \leq a \leq 255$)
Select Character Set 2	$^{E}_{C}$ 6	
Select Character Set 1	$^{E}_{C}$ 7	
Paper Out Detection Disable	$^{E}_{C}$ 8	This command is ignored.
Paper Out Detection Enable	$^{E}_{C}$ 9	This command is ignored.
Home head	$^{E}_{C}$ <	This command is ignored.
n/72" LF Pitch Set	$^{E}_{C}$ A a	($1 \leq a \leq 85$)
Page Length Set in Lines	$^{E}_{C}$ C a	($1 \leq a \leq 127$)
Page Length Set in Inches	$^{E}_{C}$ C0 a	($1 \leq a \leq 22$)

a: ASCII character; n: number

■ IBM Graphic Printer Command Codes (cont.)

Function	Command	Remarks
Horizontal Tab Set	$^{E}_{C}$ D*a1a2 ... a28*,0	(1 ≤ *a* ≤ 80) normal mode (1 ≤ *a* ≤ 132) compressed mode. When the specified HTAB position crosses the current paper width, the data is ignored. The maximum tab number is 256.
Emphasized ON	$^{E}_{C}$ E	Double printing at 2/300" spacing.
Emphasized OFF	$^{E}_{C}$ F	
Double Strike ON	$^{E}_{C}$ G	Double printing at 1/300" spacing.
Double Strike OFF	$^{E}_{C}$ H	
Set Variable Line Feeding	$^{E}_{C}$ J *a*	*a*/216" Line Feed (1 ≤ *a* ≤ 255)
480 Bit-Image Graphics Mode	$^{E}_{C}$ K*a1a2*	Data per a line is max. 480 bit. Prints about 2/5 pages without expansion memory.
960 Bit-Image Graphics Mode	$^{E}_{C}$ L*a1a2*	Data pera line is max. 960 bit. Prints about 2/5 pages without expansion memory.
Set Skip Perforation	$^{E}_{C}$ N *n*	This command is ignored.
Cancel Skip Perforation	$^{E}_{C}$ O	This command is ignored.
Super/Subscript Mode ON	$^{E}_{C}$ S *n*	*n*=0, 48 Superscript mode *n*=1, 49 Subscript mode.
Super/Subscript Mode OFF	$^{E}_{C}$ T	
Unidirectional Printing	$^{E}_{C}$ U *n*	This command is ignored.
Enlarged	$^{E}_{C}$ W *n*	*n*=1, 49 Enlarged ON *n*=0, 48 Enlarged OFF
960 Bit-Image Graphics Mode Normal Speed	$^{E}_{C}$ Y*a1a2*	Data per a line is max. 960 bit. Prints about 2/5 pages without expansion memory.
1920 Bit-Image Graphics Mode	$^{E}_{C}$ Z*a1a2*	Data per a line is 1,920 bit. Print about 2/5 pages without expansion memory.

a: ASCII character; *n*: number

■ IBM Graphic Printer Command Codes (cont.)

Function	Command	Remarks
Paper Source	E_C E_M *n*	*n*=1 TRAY *n*=M MANUAL *n*=R EJECT THE CURRENT PAGE
Paper Size	E_C d *n*	*n*=B LEGAL *n*=D LETTER *n*=H A4 *n*=R COMMERCIAL 10 *n*=S INTERNATIONAL DL *n*=U INTERNATIONAL C5 *n*=M MONARCH 7 3/4
Orientation	E_C VP E_C VL	PORTRAIT LANDSCAPE
Paper Source	//*n*//	*n*=1 TRAY *n*=M MANUAL *n*=R EJECT THE CURRENT PAGE
Paper Size	//d *n*//	*n*=B LEGAL *n*=D LETTER *n*=H A4 *n*=R COMMERCIAL 10 *n*=S INTERNATIONAL DL *n*=U INTERNATIONAL C5 *n*=M MONARCH 7 3/4
Orientation	//P// //L//	PORTRAIT LANDSCAPE

a: ASCII character; *n*: number

The commands available in Diablo 630/630 ECS emulation mode are listed below.

■ Diablo 630 Command Codes

Function	Command	Remarks
Bell	$^{B}_{L}$	
Backspace	$^{B}_{S}$	
Carriage Return	$^{C}_{R}$	
Delete	$^{D}_{L}$	This command is ignored.
Supplementary Character Select	$^{E}_{M}$	Access for one character selection when in 7-bit ECS mode.
Page End	$^{F}_{F}$	
Horizontal TAB	$^{H}_{T}$	
Line Feed	$^{L}_{F}$	
Null	$^{N}_{L}$	
Shift in	$^{S}_{I}$	8-bit ECS mode blanks the character at 80_H-$9F_H$. 7-bit ECS mode selects primary character set.
Shift Out	$^{S}_{O}$	8-bit ECS mode unblanks the character at 80_H-$9F_H$. 7-bit ECS mode selects supplementary character set.
Vertical Tab	$^{V}_{T}$	
Top Margin Set	$^{E}_{C}$ T	Set top margin at current cursor position.
Bottom Margin Set	$^{E}_{C}$ L	Set bottom margin at current cursor position.
Top/Bottom Margin Cancel	$^{E}_{C}$ C	
Left Margin Set	$^{E}_{C}$ 9	Set left margin at current cursor position.
Right Margin Set	$^{E}_{C}$ 0	Set right margin at current cursor position.
Horizontal Tab Set	$^{E}_{C}$ 1	Set right margin at current cursor position.
Horizontal Tab Cancel	$^{E}_{C}$ 8	Set right margin at current cursor position.
Vertical Tab Set	$^{E}_{C}$ – (Minus)	Set right margin at current cursor position.
All Tab Cancel	$^{E}_{C}$ 2	Horizontal and vertical tab
Lines/Page	$^{E}_{C}$ $^{F}_{F}$ *a*	Page Size=VMI **a*
Horizontal Movement Index (HMI) Set	$^{E}_{C}$ $^{U}_{S}$ *a*	HMI=1/120" x (*a*–1) (1 ≤ *a* ≤ 126)

a: ASCII character; *n*: number

■ Diablo 630 Command Codes (cont.)

Function	Command	Remarks
Default HMI Select	E_C S	
Move to Horizontal Absolute Position	E_C H_T *a*	Tab to column "*a*" (1 ≤ *a* ≤ 126)
Auto Backward Print ON	E_C /	This command is ignored due to no mechanical carriage movement.
Auto Backward Print OFF	E_C \	Same as above.
Auto CR/LF ON	E_C ?	
Auto CR/LF OFF	E_C !	
Reverse Print ON	E_C <	
Reverse Print OFF	E_C >	
Backward Print	E_C 6	Cleared by C_R.
Forward Print	E_C 5	
Vertical Movement Index VMI Set	E_C R_S *a*	VMI= 1/48" x (*a*–1) (1 ≤ *a* ≤ 126)
Move to Vertical Absolute Position	E_C V_T *a*	Not returnable to preceding page due to cut sheet. Tab to line "*a*" (1 ≤ *a* ≤ 126)
Half Line Feed	E_C U	
Backward Half Line Feed	E_C D	Not returnable to preceding page due to cut sheet.
Backward Line Feed	E_C L_F	Not returnable to preceding page due to cut sheet.
Graphic Mode ON	E_C 3	No print position change after text printing. (Cleared by C_R.)
Graphic Mode OFF	E_C 4	E_C 3 mode cancel. Exit plot mode.
Red Ribbon Print ON	E_C A	This command is ignored.
Black Ribbon Print ON	E_C B	This command is ignored.
Print Suppress Start	E_C 7	Cleared by C_R.
20_H Code Designation	E_C Y	
$7F_H$ Code Designation	E_C Z	
Proportional Spacing Mode ON	E_C P	
Proportional Spacing Mode OFF	E_C Q	
Character Spacing ON/OFF	E_C D_1 *a*	Spacing=1/120" x *a* (0 ≤ *a* ≤ 63) Positive (64 ≤ *a* ≤ 127) Negative
Underline ON	E_C E	
Underline OFF	E_C R	
Boldface Overprint ON	E_C O	Double printing at 1-dot spacing. (Cleared by C_R.)

a: ASCII character; *n*: number

■ Diablo 630 Command Codes (cont.)

Function	Command	Remarks
Shadow Print ON	$^{E}_{C}$ W	Double printing at 2-dot spacing. (Cleared by $^{C}_{R}$.)
Boldface/Shadow Print OFF	$^{E}_{C}$ &	
Carriage Setting Time Extend	$^{E}_{C}$ %	This command is ignored.
Carriage Setting Time Extend Cancel	$^{E}_{C}$ N	This command is ignored.
Auto Justify	$^{E}_{C}$ M	
Auto Center	$^{E}_{C}$ =	Cleared by $^{C}_{R}$.
1/120" Backspace	$^{E}_{C}$ $^{B}_{S}$	
Program Mode Select	$^{E}_{C}$ $^{S}_{O}$ M	This command is ignored.
Word Processor Mode Cancel	$^{E}_{C}$ X	
Printer Initialize	$^{E}_{C}$ $^{S}_{B}$ I	Power-on initialization.
Remote Error Reset	$^{E}_{C}$ $^{S}_{B}$ R	This command is ignored.
Status Byte 1 Request	$^{E}_{C}$ $^{S}_{B}$ 1	In RS-232C I/F mode only. Printer always send NULL (0x00) code to host computer.
Status Byte 3 Request	$^{E}_{C}$ $^{S}_{B}$ 3	In RS-232C I/F mode only. Printer always send NULL (0x00) code to host computer.
Memory Test Request	$^{E}_{C}$ $^{S}_{B}$ SO	This command is ignored.
Hy Plot ON (Absolute Move)	$^{E}_{C}$ G	Cleared by $^{C}_{R}$.
Hy Plot ON (Absolute Plot)	$^{E}_{C}$ G $^{B}_{L}$	Cleared by $^{C}_{R}$.
Hy Plot ON (Relative Mode)	$^{E}_{C}$ V	Cleared by $^{C}_{R}$.
Hy Plot ON (Relative Plot)	$^{E}_{C}$ V $^{B}_{L}$	Cleared by $^{C}_{R}$.
Change Plot Character	$^{E}_{C}$. 'character'	
Set Plot Precision	$^{E}_{C}$, hv	
Parameter Initialize	$^{E}_{C}$ $^{C}_{R}$ P	Initialization of print control parameters only.
Print Wheel Down Load Mode ON	$^{E}_{C}$ $^{S}_{O}$ $^{D}_{2}$	This command is ignored.
Toggles SRQ Line	$^{E}_{C}$ $^{C}_{N}$ $^{C}_{N}$	This command is ignored.
Remote Print Wheel Selection	$^{E}_{C}$ $^{S}_{N}$ (p)	This command is ignored.
X-ON/OFF Protocol	$^{E}_{C}$ $^{G}_{S}$ A	Disables $^{N}_{K}$.
X-ON/OFF Protocol	$^{E}_{C}$ $^{G}_{S}$ B	Re-enables $^{N}_{K}$.
Text Block End	$^{E}_{X}$ $^{A}_{K}$	Only when $^{E}_{X}/^{A}_{K}$ hand-shake is designated in RS-232C I/F mode.

a: ASCII character; *n*: number

■ Diablo 630 Command Codes (cont.)

Function	Command	Remarks
Paper Source	$E_C E_M n$	*n*=1 TRAY *n*=M MANUAL *n*=R EJECT THE CURRENT PAGE
Paper Size	E_C d *n*	*n*=B LEGAL *n*=D LETTER *n*=H A4 *n*=R COMMERCIAL 10 *n*=S INTERNATIONAL DL *n*=U INTERNATIONAL C5 *n*=M MONARCH 7 3/4
Orientation	E_C I E_C _	PORTRAIT LANDSCAPE
Select Font	E_C F *n* E_C FI *n* E_C FA *n* E_C G *n* E_C GI *n* E_C GA *n*	INTERNAL FONT INTERNAL FONT A FONT SLOT INTERNAL FONT & ADJUST SPACING INTERNAL FONT & ADJUST SPACING A FONT SLOT & ADJUST SPACING *n* indicates the selected font number.

a: ASCII character; *n*: number

■ Diablo 630 Command Codes (cont.)

Function	Command	Remarks
Paper Source	//*n*//	*n*=1 TRAY *n*=M MANUAL *n*=R EJECT THE CURRENT PAGE
Paper Size	//d *n*//	*n*=B LEGAL *n*=D LETTER *n*=H A4 *n*=R COMMERCIAL 10 *n*=S INTERNATIONAL DL *n*=U INTERNATIONAL C5 *n*=M MONARCH 7 3/4
Orientation	//N// //_//	PORTRAIT LANDSCAPE

Select Font	//F *n*//
	//FI *n*//
	//FA *n*//
	//G *n*
	//GI *n*//
	//GA *n*//
		INTERNAL FONT
		INTERNAL FONT
		A FONT SLOT
		INTERNAL FONT & ADJUST SPACING
		INTERNAL FONT & ADJUST SPACING
		A FONT SLOT & ADJUST SPACING
		n indicates the selected font number.

a: ASCII character; *n*: number

■ Mixed Print Mode

n (dec.)	En	D	Em	C	El
0					
1					O
2					
3					O
4				O	
5				O	O
6				O	
7				O	O
8			O		
9					O
10			O		
11					O
12			O		
13				O	O
14			O		
15				O	O
16		O			
17		O			O
18		O			
19		O			O
20		O		O	
21		O		O	O
22		O		O	
23		O		O	O
24		O	O		
25		O			O
26		O	O		
27		O			O
28		O	O		
29		O		O	O
30		O	O		
31		O		O	O

n (dec.)	En	D	Em	C	El
32	O				
33	O				O
34	O				
35	O				O
36	O			O	
37	O			O	O
38	O			O	
39	O			O	O
40	O		O		
41	O				O
42	O		O		
43	O				O
44	O		O		
45	O			O	O
46	O		O		
47	O			O	O
48	O	O			
49	O	O			O
50	O	O			
51	O	O			O
52	O	O		O	
53	O	O		O	O
54	O	O		O	
55	O	O		O	O
56	O	O	O		
57	O	O			O
58	O	O	O		
59	O	O			O
60	O	O	O		
61	O	O		O	O
62	O	O	O		
63	O	O		O	O

En: Enlarged mode
D: Double-strike mode
Em: Emphasized mode
C: Condensed mode
El: Elite-size mode

■ International Character Table

Dec code		Dec code		Dec code		Dec code		Dec code		Dec code	
0	à	13	CR	26	ä	128	*à*	141	CR	154	*ä*
1	è	14	SO	27	ESC	129	*è*	142	SO	155	ESC
2	ù	15	SI	28	ü	130	*ù*	143	SI	156	*ü*
3	ò	16	§	29	É	131	*ò*	144	*§*	157	*É*
4	ì	17	ß	30	é	132	*ì*	145	*ß*	158	*é*
5	°	18	DC2	31	¥	133	°	146	DC2	159	¥
6	£	19	DC3			134	£	147	DC3		
7	BEL	20	DC4			135	BEL	148	DC4		
8	BS	21	ø			136	BS	149	*ø*		
9	HT	22	¨			137	HT	150	¨		
10	LF	23	Ä			138	LF	151	*Ä*		
11	VT	24	CAN			139	VT	152	CAN		
12	FF	25	Ü			140	FF	153	*Ü*		

■ International Character Set

n	Country
0	U.S.A.
1	France
2	Germany
3	England
4	Denmark
5	Sweden
6	Italy
7	Spain
8	Japan
9	Norway
10	Denmark II

Example

APPENDIX

CHARACTER TABLES

The tables in this appendix show the character sets available in each of the emulation modes supported by the JX-9400 Laser Printer.

■ HP PCL 4

Courier 12 point 10 cpi ROMAN-8

UPPER 4 BIT

LO \ HI	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	NUL	DEL		0	@	P	`	p				¯	â	Â	Á	Þ
1	SOH	DC1	!	1	A	Q	a	q			À	Ý	ê	î	Ã	þ
2	STX	DC2	"	2	B	R	b	r			Â	ý	ô	Ø	ã	·
3	ETX	DC3	#	3	C	S	c	s			È	°	û	Æ	Đ	µ
4	EOT	DC4	$	4	D	T	d	t			Ê	Ç	á	å	ð	¶
5	ENQ	NAK	%	5	E	U	e	u			Ë	ç	é	í	Í	¾
6	ACK	SYN	&	6	F	V	f	v			Î	Ñ	ó	ø	Ì	-
7	BEL	ETB	'	7	G	W	g	w			Ï	ñ	ú	æ	Ó	½
8	BS	CAN	(	8	H	X	h	x			´	¡	à	Ä	Ò	½
9	HT	EM	)	9	I	Y	i	y			`	¿	è	ì	Õ	ª
10	LF	SUB	*	:	J	Z	j	z			^	¤	ò	Ö	õ	º
11	VT	ESC	+	;	K	[	k	{			¨	£	ù	Ü	Š	«
12	FF	PS	,	<	L	\	l	|		~	¥	ä	É	š	■
13	CR	GS	-	=	M	]	m	}			Ù	§	ë	ï	Ú	»
14	SO	RS	.	>	N	^	n	~			Û	ƒ	ö	ß	Ÿ	±
15	SI	US	/	?	O	_	o	▒			£	ç	ü	Ô	ÿ	

LOWER 4 BIT

ISO Symbol Sets

■ ISO Symbol Sets

			DECIMAL CHARACTER EQUIVALENTS											
ISO	NAME	ID	23	24	40	5B	5C	5D	5E	60	7B	7C	7D	7E
6	ASCII	0U	#	$	@	[	\	]	^	`	{	|	}	~
2	ISO IRV	2U	#	¤	@	[	\	]	^	`	{	|	}	¯
4	ISO United Kingdom	1E	£	$	@	[	\	]	^	`	{	|	}	¯
25	ISO French	0F	£	$	à	°	Ç	§	^	`	é	ù	è	¨
69	ISO French	1F	£	$	à	°	Ç	§	^	µ	é	ù	è	¨
	German	0G	£	$	§	Ä	Ö	Ü	^	`	ä	ö	ü	ß
21	ISO German	1G	#	$	§	Ä	Ö	Ü	^	`	ä	ö	ü	ß
15	ISO Italian	0I	£	$	§	°	Ç	é	^	ù	à	ò	è	ì
14	JIS ASCII	0K	#	$	@	[	¥	]	^	`	{	|	}	¯
57	ISO Chinese	2K	#	¥	@	[	\	]	^	`	{	|	}	¯
10	ISO Swedish	3S	#	¤	@	Ä	Ö	Å	^	`	ä	ö	å	¯
11	ISO Swedish	0S	#	¤	É	Ä	Ö	Å	Ü	é	ä	ö	å	ü
	Spanish	1S	#	$	@	¡	Ñ	¿	°	`	{	ñ	}	~
17	ISO Spanish	2S	£	$	§	¡	Ñ	¿	^	`	°	ñ	ç	~
85	ISO Spanish	6S	#	$	·	¡	Ñ	Ç	¿	`	´	ñ	ç	¨
16	ISO Portuguese	4S	#	$	§	Ã	Ç	Õ	^	`	ã	ç	õ	°
84	ISO Portuguese	5S	#	$	´	Ã	Ç	Õ	^	`	ã	ç	õ	~
60	ISO Norwegian v1	0D	#	$	@	Æ	Ø	Å	^	`	æ	ø	å	¯
61	ISO Norwegian v2	1D	§	$	@	Æ	Ø	Å	^	`	æ	ø	å	|

■ HP PCL 4
Courier 12 point 10 cpi IBM-US

UPPER 4 BIT

LOWER 4 BIT

HI / LO	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0		►		0	@	P	`	p	Ç	É	á	▒	└	╨	α	≡
1	☺	◄	!	1	A	Q	a	q	ü	æ	í	▓	┴	╤	ß	±
2	☻	↕	"	2	B	R	b	r	é	Æ	ó	▓	┬	╥	Γ	≥
3	♥	‼	#	3	C	S	c	s	â	ô	ú	┃	├	╙	π	≤
4	♦	¶	$	4	D	T	d	t	ä	ö	ñ	┤	─	╘	Σ	⌠
5	♣	§	%	5	E	U	e	u	à	ò	Ñ	╡	┼	╒	σ	⌡
6	♠	▬	&	6	F	V	f	v	å	û	ª	╢	╞	╓	μ	÷
7	•	↨	'	7	G	W	g	w	ç	ù	º	╖	╟	╫	τ	≈
8	◘	↑	(	8	H	X	h	x	ê	ÿ	¿	╕	╚	╪	Φ	°
9	○	↓	)	9	I	Y	i	y	ë	Ö	⌐	╣	╔	┘	Θ	∙
10	◙	→	*	:	J	Z	j	z	è	Ü	¬	║	╩	┌	Ω	·
11	♂	←	+	;	K	[	k	{	ï	¢	½	╗	╦	█	δ	√
12	♀	∟	,	<	L	\	l	|	î	£	¼	╝	╠	▄	∞	n
13	♪	↔	-	=	M	]	m	}	ì	¥	¡	╜	═	▌	φ	²
14	♫	▲	.	>	N	^	n	~	Ä	₧	«	╛	╬	▐	ε	■
15	☼	▼	/	?	O	_	o	⌂	Å	ƒ	»	┐	╧	▀	∩	

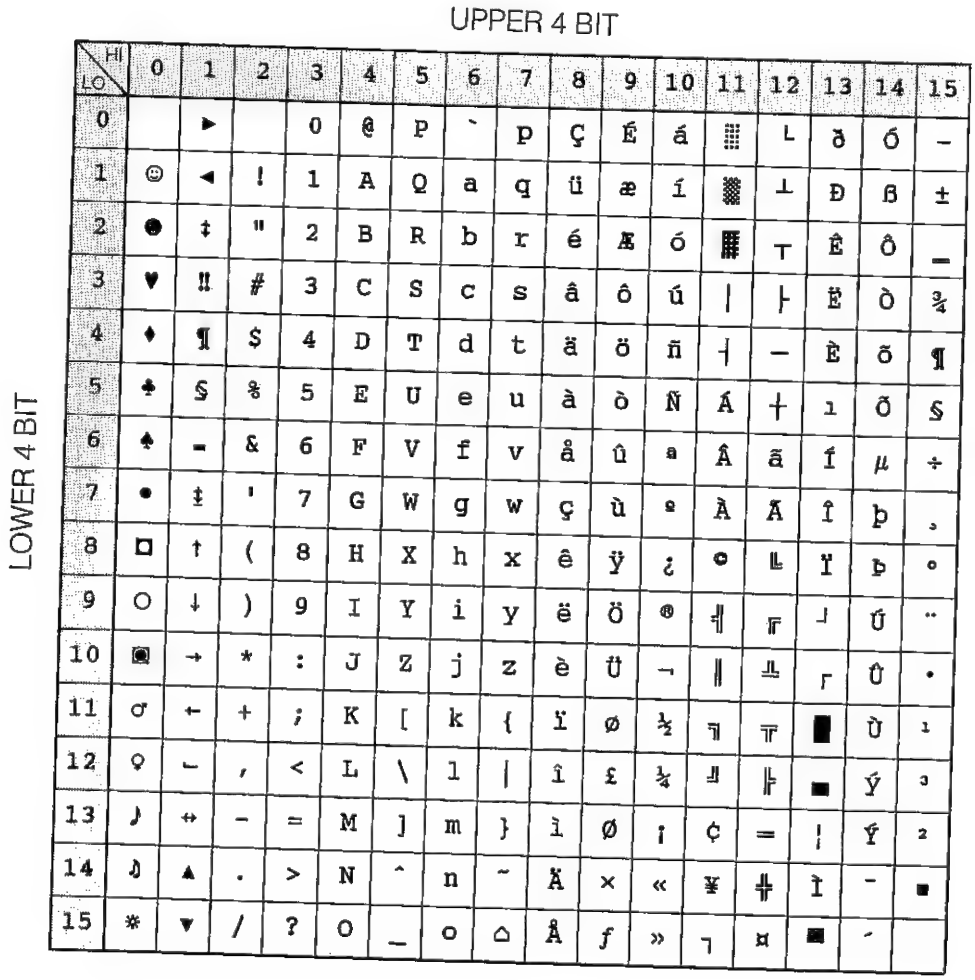
■ **HP PCL 4**
Courier 12 point 10 cpi IBM-D/N

UPPER 4 BIT

HI / LO	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0		►		0	@	P	`	p	Ç	É	á	▒	└	╨	α	≡
1	☺	◄	!	1	A	Q	a	q	ü	æ	í	▓	┴	╤	ß	±
2	●	↕	"	2	B	R	b	r	é	Æ	ó	▓	┬	╥	Γ	≥
3	♥	‼	#	3	C	S	c	s	â	ô	ú	┃	├	╙	π	≤
4	♦	¶	$	4	D	T	d	t	ä	ö	ñ	┤	─	╘	Σ	⌠
5	♣	§	%	5	E	U	e	u	à	ò	Ñ	╡	┼	╒	σ	⌡
6	♠	▬	&	6	F	V	f	v	å	û	õ	╢	╞	╓	µ	÷
7	•	↨	'	7	G	W	g	w	ç	ù	Õ	╖	╟	╫	τ	≈
8	◘	↑	(	8	H	X	h	x	ê	ÿ	¿	╕	╚	╪	Φ	°
9	○	↓	)	9	I	Y	i	y	ë	Ö	ã	╣	╔	┘	Θ	•
10	◙	→	*	:	J	Z	j	z	è	Ü	Ã	║	╩	┌	Ω	·
11	♂	←	+	;	K	[	k	{	ï	ø	ℓ	╗	╦	▉	δ	√
12	♀	∟	,	<	L	\	l	|	î	£	ñ	╝	╠	■	∞	ⁿ
13	♪	↔	-	=	M	]	m	}	ì	Ø	¡	╜	═	▌	φ	²
14	♫	▲	.	>	N	^	n	~	Ä	Ł	ª	╛	╬	▐	ϵ	■
15	☼	▼	/	?	O	_	o	⌂	Å	ł	º	┐	╧	■	∩	

LOWER 4 BIT

■ HP PCL 4
Courier 12 point 10 cpi PC-850



LO \ HI	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0		►		0	@	P	`	p	Ç	É	á	▒	└	ð	Ó	-
1	☺	◄	!	1	A	Q	a	q	ü	æ	í	▓	┴	Ð	ß	±
2	☻	↕	"	2	B	R	b	r	é	Æ	ó	▓	┬	Ê	Ô	‗
3	♥	‼	#	3	C	S	c	s	â	ô	ú	┃	├	Ë	Ò	¾
4	♦	¶	$	4	D	T	d	t	ä	ö	ñ	┤	─	È	õ	¶
5	♣	§	%	5	E	U	e	u	à	ò	Ñ	Á	┼	ı	Õ	§
6	♠	▬	&	6	F	V	f	v	å	û	ª	Â	ã	Í	µ	÷
7	•	↨	'	7	G	W	g	w	ç	ù	º	À	Ã	Î	þ	¸
8	◘	↑	(	8	H	X	h	x	ê	ÿ	¿	©	╚	Ï	Þ	°
9	○	↓	)	9	I	Y	i	y	ë	Ö	®	╣	╔	┘	Ú	¨
10	◙	→	*	:	J	Z	j	z	è	Ü	¬	║	╩	┌	Û	·
11	♂	←	+	;	K	[	k	{	ï	ø	½	╗	╦	█	Ù	¹
12	♀	∟	,	<	L	\	l	|	î	£	¼	╝	╠	▄	ý	³
13	♪	↔	-	=	M	]	m	}	ì	Ø	¡	¢	═	¦	Ý	²
14	♫	▲	.	>	N	^	n	~	Ä	×	«	¥	╬	Ì	¯	■
15	☼	▼	/	?	O	_	o	⌂	Å	ƒ	»	┐	¤	▀	´	

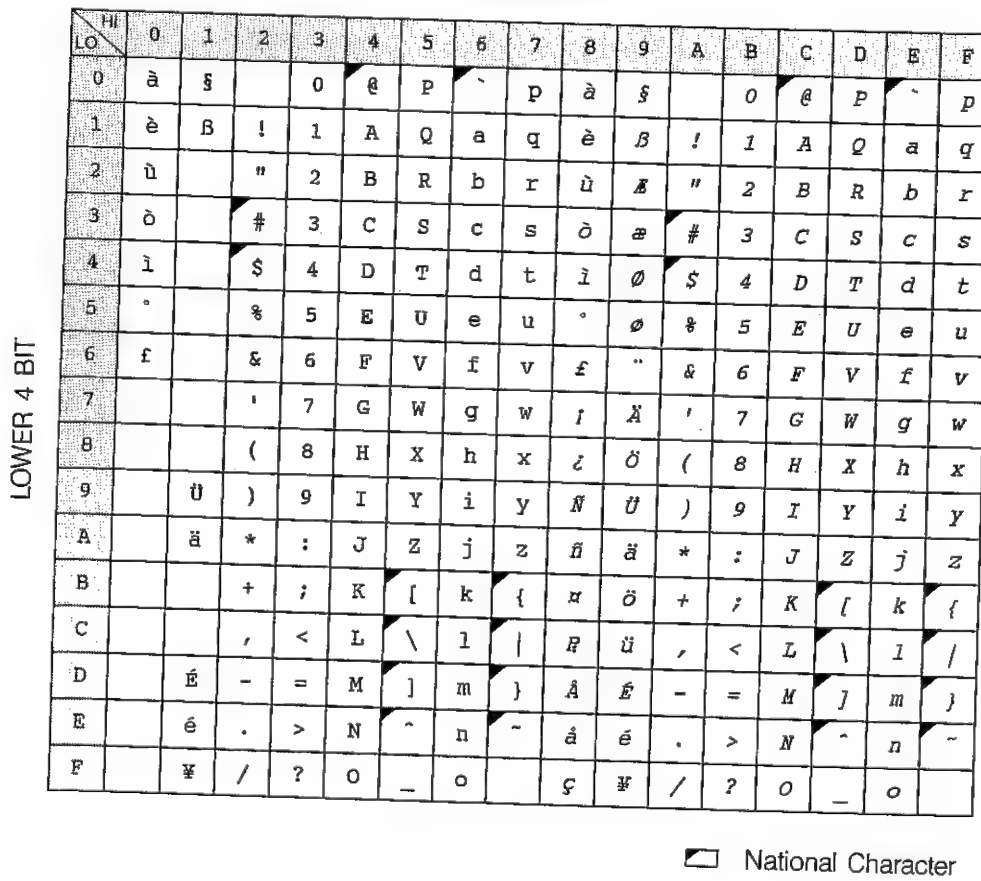
■ HP PCL 4
Courier 12 point 10 cpi ECMA-94

UPPER 4 BIT

LOWER 4 BIT

HI / LO	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0				0	@	P	`	p				°	À	Ð	à	ð
1			!	1	A	Q	a	q			¡	±	Á	Ñ	á	ñ
2			"	2	B	R	b	r			¢	²	Â	Ò	â	ò
3			#	3	C	S	c	s			£	³	Ã	Ó	ã	ó
4			$	4	D	T	d	t			¤	´	Ä	Ô	ä	ô
5			%	5	E	U	e	u			¥	µ	Å	Õ	å	õ
6			&	6	F	V	f	v			¦	¶	Æ	Ö	æ	ö
7			'	7	G	W	g	w			§	·	Ç	×	ç	÷
8			(	8	H	X	h	x			¨	¸	È	Ø	è	ø
9			)	9	I	Y	i	y			©	¹	É	Ù	é	ù
10			*	:	J	Z	j	z			ª	º	Ê	Ú	ê	ú
11			+	;	K	[	k	{			«	»	Ë	Û	ë	û
12			,	<	L	\	l	|			¬	¼	Ì	Ü	ì	ü
13			-	=	M	]	m	}			-	½	Í	Ý	í	ý
14			.	>	N	^	n	~			®	¾	Î	Þ	î	þ
15			/	?	O	_	o	▒			¯	¿	Ï	ß	ï	ÿ

■ Epson FX-80
Courier 12 point 10 cpi USASCII+ITALIC



LO \ HI	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	à	§		0	@	P	`	p	*à*	*§*		*0*	*@*	*P*	*`*	*p*
1	è	ß	!	1	A	Q	a	q	*è*	*ß*	*!*	*1*	*A*	*Q*	*a*	*q*
2	ù		"	2	B	R	b	r	*ù*	*Æ*	*"*	*2*	*B*	*R*	*b*	*r*
3	ò		#	3	C	S	c	s	*ò*	*æ*	*#*	*3*	*C*	*S*	*c*	*s*
4	ì		$	4	D	T	d	t	*ì*	*Ø*	*$*	*4*	*D*	*T*	*d*	*t*
5	°		%	5	E	U	e	u	*°*	*ø*	*%*	*5*	*E*	*U*	*e*	*u*
6	£		&	6	F	V	f	v	*£*	*¨*	*&*	*6*	*F*	*V*	*f*	*v*
7			'	7	G	W	g	w	*ſ*	*Å*	*'*	*7*	*G*	*W*	*g*	*w*
8			(	8	H	X	h	x	*¿*	*Ö*	*(*	*8*	*H*	*X*	*h*	*x*
9		Ü	)	9	I	Y	i	y	*Ñ*	*Ü*	*)*	*9*	*I*	*Y*	*i*	*y*
A		ä	*	:	J	Z	j	z	*ñ*	*ä*	*	*:*	*J*	*Z*	*j*	*z*
B			+	;	K	[	k	{	*¤*	*ö*	*+*	*;*	*K*	*[*	*k*	*{*
C			,	<	L	\	l	|	*Ñ*	*ü*	*,*	*<*	*L*	**	*l*	*/*
D		É	-	=	M	]	m	}	*Å*	*É*	*-*	*=*	*M*	*]*	*m*	*}*
E		é	.	>	N	^	n	~	*å*	*é*	*.*	*>*	*N*	*^*	*n*	*~*
F		¥	/	?	O	_	o		*Ç*	*¥*	*/*	*?*	*O*	*_*	*o*	

■ National Character Table

	A3 23	A4 24	C0 40	DB 5B	DC 5C	DD 5D	DE 5E	E0 60	FB 7B	FC 7C	FD 7D	FE 7E
USA	#	$	@	[	\	]	^	`	{	|	}	~
FRANCE	#	$	à	°	ç	§	^	`	é	ù	è	¨
GERMANY	#	$	§	Ä	Ö	Ü	^	`	ä	ö	ü	ß
ENGLAND	£	$	@	[	\	]	^	`	{	|	}	~
DENMARK 1	#	$	@	Æ	Ø	Å	^	`	æ	ø	å	~
SWEDEN	#	¤	É	Ä	Ö	Å	Ü	é	ä	ö	å	ü
ITALY	#	$	@	°	\	é	^	ù	à	ò	è	ì
SPAIN	₧	$	@	¡	Ñ	¿	^	`	¨	ñ	}	~
JAPAN	#	$	@	[	¥	]	^	`	{	|	}	~
NORWAY	#	¤	É	Æ	Ø	Å	Ü	é	æ	ø	å	ü
DENMARK 2	#	$	É	Æ	Ø	Å	Ü	é	æ	ø	å	ü

■ IBM Proprinter
Courier 12 point 10 cpi USASCII+IBM CHR.

UPPER 4 BIT

LOWER 4 BIT

HI / LO	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0				0	@	P	`	p	Ç	É	á	▒	└	╨	α	≡
1			!	1	A	Q	a	q	ü	æ	í	▒	┴	╤	ß	±
2			"	2	B	R	b	r	é	Æ	ó	▓	┬	╥	Γ	≥
3	♥		#	3	C	S	c	s	â	ô	ú	│	├	╙	π	≤
4	♦	¶	$	4	D	T	d	t	ä	ö	ñ	┤	─	╘	Σ	⌠
5	♣	§	%	5	E	U	e	u	à	ò	Ñ	╡	┼	╒	σ	⌡
6	♠		&	6	F	V	f	v	å	û	ª	╢	╞	╓	µ	÷
7			'	7	G	W	g	w	ç	ù	º	╖	╟	╫	τ	≈
8			(	8	H	X	h	x	ê	ÿ	¿	╕	╚	╪	Φ	°
9			)	9	I	Y	i	y	ë	Ö	⌐	╣	╔	┘	Θ	∙
A		→	*	:	J	Z	j	z	è	Ü	¬	║	╩	┌	Ω	·
B		←	+	;	K	[	k	{	ï	¢	½	╗	╦	█	δ	√
C			,	<	L	\	l	|	î	£	¼	╝	╠	▄	∞	ⁿ
D			-	=	M	]	m	}	ì	¥	¡	╜	═	▌	φ	²
E			.	>	N	^	n	~	Ä	₧	«	╛	╬	▐	∈	■
F		Ø	/	?	O	_	o		Å	ƒ	»	┐	╧	▀	∩	

▭ National Character

■ National Character Table

	30	9B	9D	9E	9F	A6	A7	A9	AA	AB	AC	AE	AF
International	0	¢	¥	₧	ƒ	ª	º	⌐	¬	½	¼	«	»
Norway/Denmark	0	ø	Ø	L	l·	õ	Õ	ã	Ã	ℓ	ń	³	¤

■ IBM Graphics Printer
Courier 12 point 10 cpi USASCII+IBM CHR.

UPPER 4 BIT

LO \ HI	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0				0	@	P	`	p	Ç	É	á	▒	└	┴	α	≡
1			!	1	A	Q	a	q	ü	æ	í	▓	┴	┬	ß	±
2			"	2	B	R	b	r	é	Æ	ó	▓	┬	┬	Γ	≥
3	♥		#	3	C	S	c	s	â	ô	ú	│	├	└	π	≤
4	♦		$	4	D	T	d	t	ä	ö	ñ	┤	─	└	Σ	⌠
5	♣	§	%	5	E	U	e	u	à	ò	Ñ	┤	┼	┌	σ	⌡
6	♠		&	6	F	V	f	v	å	û	ª	┤	├	┌	μ	÷
7			'	7	G	W	g	w	ç	ù	º	┐	├	┼	τ	≈
8			(	8	H	X	h	x	ê	ÿ	¿	┐	└	┼	Φ	°
9			)	9	I	Y	i	y	ë	Ö	⌐	┤	┌	┘	Θ	·
A			*	:	J	Z	j	z	è	Ü	¬	│	┴	┌	Ω	·
B			+	;	K	[	k	{	ï	¢	½	┐	┬	▉	δ	√
C			,	<	L	\	l	|	î	£	¼	┘	├	■	∞	ⁿ
D			-	=	M	]	m	}	ì	¥	¡	┘	─	▌	φ	²
E			.	>	N	^	n	~	Ä	₧	«	┘	┼	▌	ε	■
F			/	?	O	_	o		Å	ƒ	»	┐	┴	■	∩	

LOWER 4 BIT

National Character

■ National Character Table

	30	9B	9D	9E	9F	A6	A7	A9	AA	AB	AC	AE	AF
International	0	Ç	¥	₧	ƒ	ª	º	⌐	¬	½	¼	«	»
Norway/Denmark	0	ø	Ø	L	l·	õ	Õ	ã	Ã	ℓ	ń	³	¤

■ Diablo 630/630 ECS
Courier 12 point 10 cpi USASCII

UPPER 4 BIT

LO \ HI	0	1	2	3	4	5	6	7
0			¢	0	@	P	`	p
1			!	1	A	Q	a	q
2			"	2	B	R	b	r
3			#	3	C	S	c	s
4			$	4	D	T	d	t
5			%	5	E	U	e	u
6			&	6	F	V	f	v
7			'	7	G	W	g	w
8			(	8	H	X	h	x
9			)	9	I	Y	i	y
A			*	:	J	Z	j	z
B			+	;	K	[	k	{
C			,	<	L	\	l	|
D			-	=	M	]	m	}
E			.	>	N	^	n	~
F			/	?	O	_	o	¬

LOWER 4 BIT

National Character

■ National character Table

	23	24	40	5B	5C	5D	5E	60	7B	7C	7D	7E
USA	#	$	@	[	\	]	^	`	{	|	}	~
FRANCE	#	$	à	°	ç	§	^	`	é	ù	è	¨
GERMANY	#	$	§	Ä	Ö	Ü	^	`	ä	ö	ü	ß
ENGLAND	£	$	@	[	\	]	^	`	{	|	}	~
DENMARK 1	#	$	@	Æ	Ø	Å	^	`	æ	ø	å	~
SWEDEN	#	¤	É	Ä	Ö	Å	Ü	é	ä	ö	å	ü
ITALY	#	$	@	°	\	é	^	ù	à	ò	è	ì
SPAIN	₧	$	@	¡	Ñ	¿	^	`	¨	ñ	}	~
JAPAN	#	$	@	[	¥	]	^	`	{	|	}	~
NORWAY	#	¤	É	Æ	Ø	Å	Ü	é	æ	ø	å	ü
DENMARK 2	#	$	É	Æ	Ø	Å	Ü	é	æ	ø	å	ü

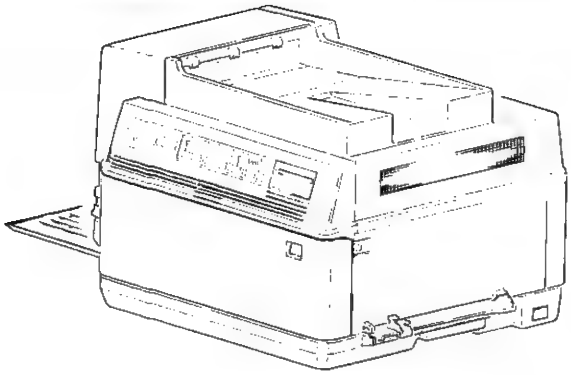
SHARP®

SHARP CORPORATION

PRINTED IN JAPAN
3AT(TINSE0080GCZZ)①

SHARP SERVICE MANUAL

CODE: 00ZJX9300S/ME



LASER PRINTER

MODEL JX9300

CONTENTS

CAUTION

This laser printer is a class 1 laser product complied with 21CFR 1040.10 and 1040.11 of the CDRH standard and IEC825. This means that this machine does not produce a hazadous laser radiation. The use of controls or adjustments or performance of procedures other than those specified herein may result in hazadous radiation exposure.

This laser radiation is not a danger to the skin, but when an exact forcusing of the laser beam is achieved on the eye's retina, there is danger of spot damage to the retina.

The following cautions must be observed to avoid exposure of the laser beam to your eyes at the time of servicing.

1) When a problem in the laser optical unit has occured, the whole optical unit must be exchanged as a unit, not an individual part.
2) Do not look into the machine with the main switch turned on after removing the developer unit, toner cartridge, and drum cartridge.
3) Do not look into the laser beam exposure slit of the laser optical unit with the connector connected when removing and installing the optical system.
4) The front cabinet contains the safety interlock switch.

   Do not defeat the safety interlock by inserting wedges or other items into the switch slot.

   The required Labels and hazard warnings from IEC standard 825.

   (220V, 240V machine only)

CLASS 1
LASER PRODUCT

LASER KLASSE 1

CAUTION

INVISIBLE LASER RADIATION,
WHEN INTERLOCKS DEFEATED AND
TONER-DEVELOPER CARTRIDGE REMOVED.

VORSICHT

UNSICHTBARE LASERSTRAHLUNG,
WENN INTERLOCK ÜBERBRÜCKT IST UND
TONER-SOWIE ENTWICKLUNGSEINHEIT
ENTFERNT SIND.

SHARP CORPORATION

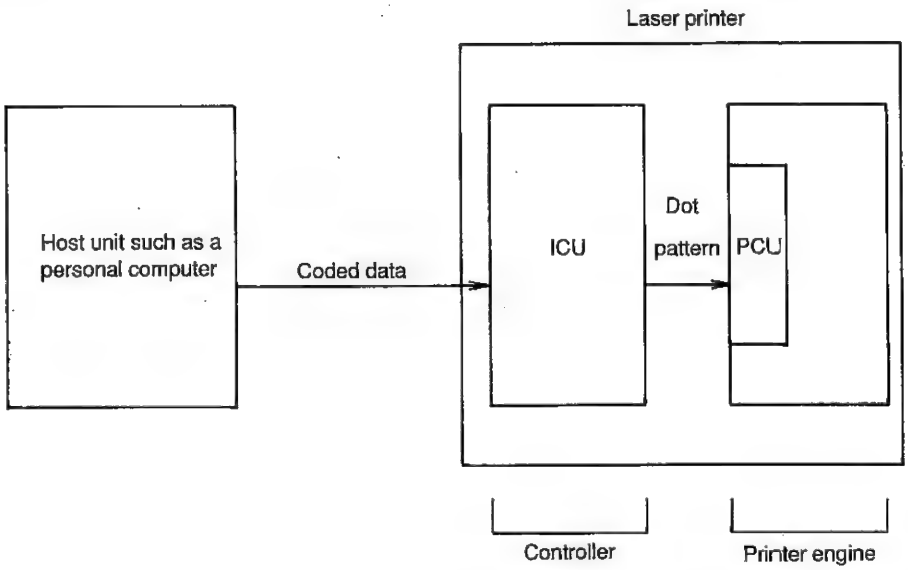
To begin with

Laser printer is used in connection with the host as a personal computer from which the print data is supplied.

The laser printer consists of two major blocks of the controller and the print engine.

The controller consists of the ICU (Interface Control Unit) which is employed to interpret the source print data to create dot pattern information based on the font.

The print engine is the block employed to print the data of the dot pattern information. The print engine includes the laser print mechanism, drum mechanism, and paper feed mechanism which are controlled by PCU (Process Control Unit). Dot pattern information is sent to the laser print block that is controlled by the PCU where the data is converted into laser beams.



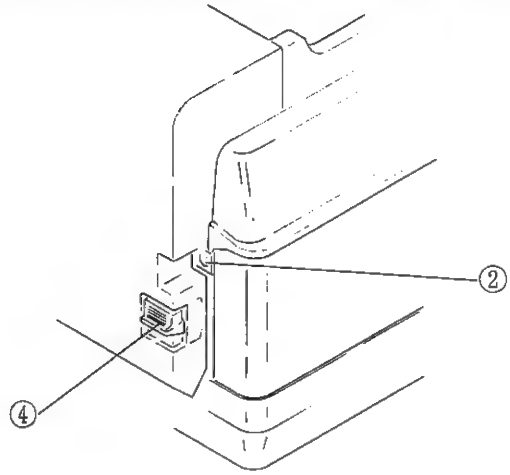
This Service Manual describes the printer engine, the PCU (Process Control Unit) which controls the printer engine, and the ICU (Interface Control Unit) which analyzes code data from the host to form dot patterns in this sequence.

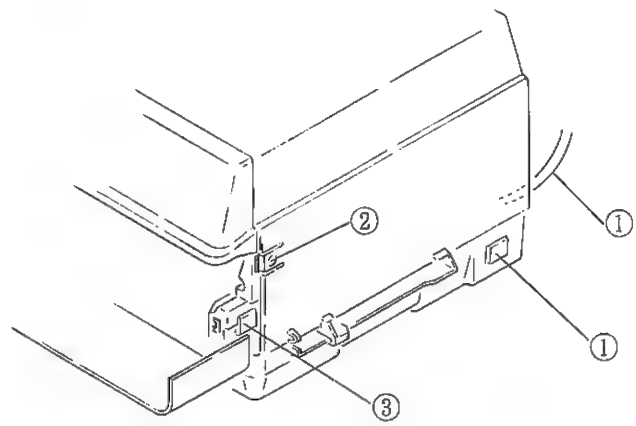
Contents of printer engine and ICU section

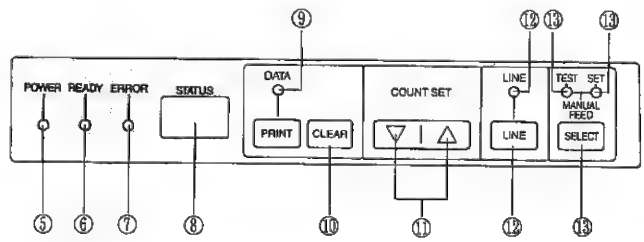
[1] BASIC SPECIFICATIONS

Type:	Desktop
Printing system:	Dry-type electrostatic plain paper print by laser image exposure
Recording density:	300 dpi
Paper feed system:	100-sheet cassette and manual feeds, cassette stored under the machine.
Print size:	AB series: A4, B5, A5 Inch series: Letter, invoice (legal size as an option)
Print speed:	6 sheets/minute
First print:	20 seconds, maximum, not including restoration from the sleep mode, at the rated voltage, room temperature of 20°C, and 65%RH
Multipage printing:	Host controlled or control panel controlled.
Paper delivery:	Facedown tray: 200 pages Faceup tray: 30 sheets (option)
Developing system:	Magnetic brush development (2-component developer), black only
Cleaning method:	By means of the cleaning blade embedded in the drum cartridge
Fusing method:	Heat roller type Upper fuser roller (teflon coated) Lower fuser roller (silicon rubber)
Interface:	Video interface (Centronics parallel interface) (RS232C serial interface) ( ) with controller
Power requirements:	120/220/240VAC, 50/60Hz, detachable AC cord
Power consumption:	0.7kW, maximum
Operational noise:	53dBA, maximum during operation, except for impact noise 45dBA, maximum, during standby
Physical dimensions:	18(W) x 17(D) x 13(H) inches
Weight:	39 lbs.
Accessories:	Photoconductor cartridge x1 Developer cartridge (developer included) x1 Toner cartridge (toner included) x1 Toner collecting container x1 Semi-universal cassette (letter size at maximum) x1 Corona wire cleaner x1 AC cord x1
Supplies:	Photoconductor cartridge Developer cartridge Toner kit (Toner cartridge and toner collecting container)
Options:	Faceup tray Expansion memory, 1.5MB Font card Legal cassette

[2] OPERATOR PANEL DESCRIPTION







① POWER switch, power supply cord
A pushbutton is used to turn the power on and off. An inlet type power supply cord is used to allow quick disconnection from the printer for easier machine installation and relocation.

② Front cover release button
Used to open the front panel when replacing the developer cartridge, toner cartridge, or toner collecting container. A button is provided at both sides of the front panel.

③ Upper half release button
Used to release the shell lock when removing a misfed paper or replacing the photoconductor cartridge. The upper panel bounces when opening the shell, your hand must be spread over the facedown tray to contain it.

④ Facedown/faceup select button
Used to select which tray is to be used, faceup or facedown.

⑤ POWER Lamp (green)
Turns active when the power is on to the printer.

⑥ READY lamp (green)
The READY indicator comes active when the printer has reached warmup and is ready to print.

If a toner empty condition is encountered at power on, it will need a maximum two minutes before the machine is ready to print with the READY indicator active. The READY indicator will keep flashing during the warmup period and toner density adjustment, and is off when an error occurs.

⑦ ERROR lamp (red)
This indicator comes on or flashes when the printer is not ready. Blinking indicator indicates a user related error and constantly activating indicator indicates the condition must be handled by an authorized service technician.

⑧ Status Display
A two-digit status display is normally off. The indicator will come active with alphanumeric characters when one of the following is encountered.

(A) Occurrence of an error. Error kind is prompted.

(B) Mode in the diagnostic condition

(C) Function setting modes

⑨ Data lamp (yellow)/PRINT switch
The PRINT lamp comes active when there is data in the printer to be printed. If the data from the host was interrupted without a page complete code (form feed code) while the indicator is active, the indicator blinks to inform you that there is data remaining. This remaining data can be printed when the PRINT switch is pushed after setting the printer in the offline mode. The PRINT switch is also used for functional setting and diag program execution key.

⑩ CLEAR key
Used in the off-line to clear an error.

⑪ UP(Δ), DOWN(∇) key
Used to select function in the functional select mode and to select test mode.

⑫ LINE indicator (green), LINE key
The key is used to select online or offline mode between the printer and the host. The LINE indicator comes active when in the ONLINE mode.
When the LINE key is depressed in the online mode to go into the offline mode, the printer is interrupted and ejects the current page (halt function). Depressing the key again causes the printer to resume printing. The LINE indicator may blink when the LINE key is pushed to go into the offline mode. In this event, the font cartridge should not be exchanged as it indicates that the printer is in a middle of internal execution or in transition during page printing.

⑬ TEST indicator (orange), SET indicator (orange), SELECT key
The TEST indicator is active during test. The SET indicator is active during functional setting. When both the TEST and SET indicators are active, it indicates that the printer is in the manual feed mode.
The SELECT key is used in the above three conditions. Depression of the SELECT key in the offline mode changes the mode from test to set, set to normal, and normal to test. When the SELECT key is pushed in the online mode, the control goes into the manual feed mode. This manual feed mode can be canceled by the depression of the SELECT key again.

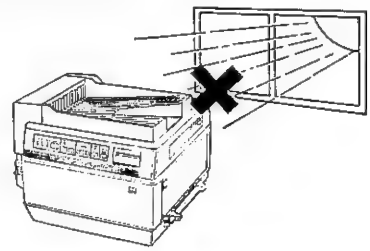
[3] UNPACKING AND INSTALLATION

1. Installation requirements:

Please note the following requirements when installing the printer.

1) Machine Environment

① Avoid installation in direct sunlight or bright locations near a window.
Direct sunlight may cause the plastic components to deform or discolor.
Use a curtain or shade to block the light. Frosted glass may also produce the same effect.

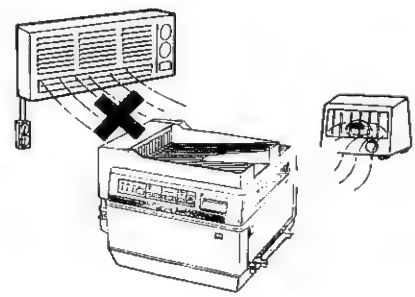


② Avoid installation in a hot, damp place or where rapid changes in humidity occur (for example; near an air conditioner).

This may cause paper to dampen or frost to occur inside the printer, and may lead to a misfeed and a deterioration in the print quality.
The recommended environmental conditions are:

20 to 25°C (68 to 77°F.), 65%±5%RH.
The nominal environment conditions are:
10 to 30°C. (40 to 86°F.), 20 to 85%RH.

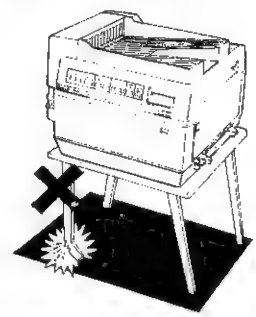
If the temperature is 35°C. (95°F), the humidity should be 60%.



③ The toner density and print quality may be affected unless the machine is installed in a level condition.

④ Avoid installation in a place where dust or vibration is encountered.
Dust deposits inside of the printer may lead to a deterioration of print quality or machine trouble.

⑤ Do not install the printer on an unstable or uneven surface. The printer must be placed on a level surface to permit proper functioning.

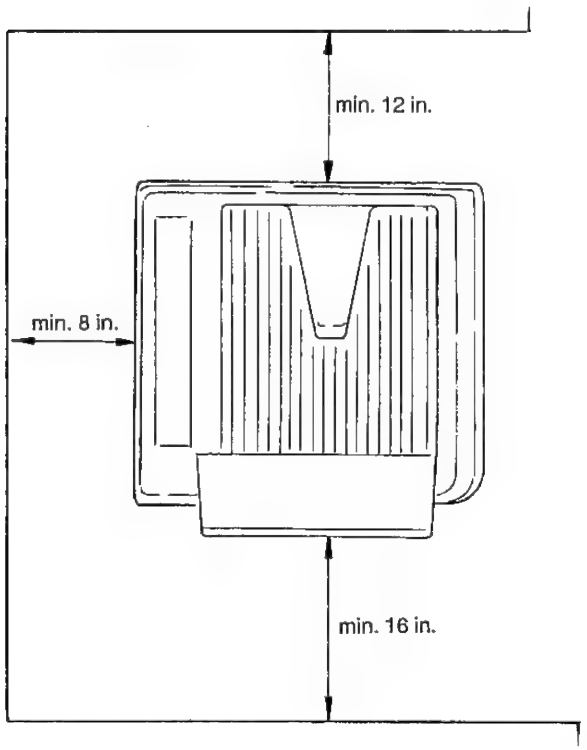


⑥ Avoid installation in a place where the ventilation or air circulation is poor.

⑦ Never install the printer near inflammable materials or in the presence of ammonia fumes.
Installation near a diazo copy machine may lead to a deterioration of print quality or a machine malfunction.

⑧ Install the printer near the wall outlet.

2) Space around the printer
The printer requires at least 8 inches of clearance between the rear side and the wall. This space is required for proper cooling fan ventilation. Adequate working space around the machine should also be allowed for ease of operation.



3) Power source

① The power supply line should have a capacity of more than 6A (120V), 3.2A (220V), 3.0A (240V), capable of supplying more than 90% of the rated voltage at full load.

② Do not use an extension cord, or operate any other equipment from the same wall outlet.

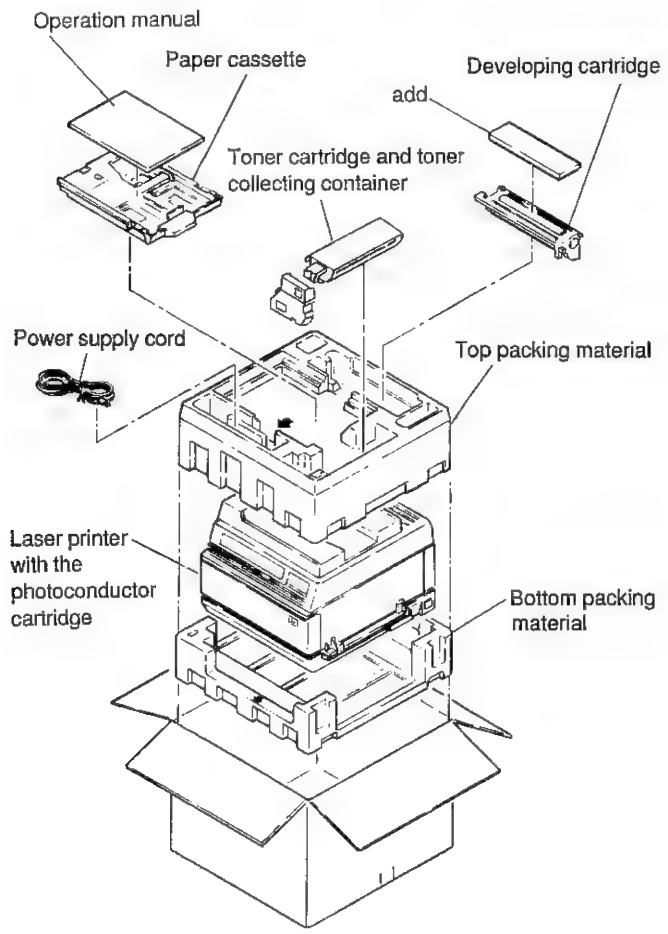
③ Use a properly grounded (three prong) wall outlet only.

2. Unpacking and installation procedures

1) Metallic surface of the printer might be frosted due to a abrupt temperature change when the machine is brought inside the room during cold weather and may lead to a paper misfeed or print quality deterioration. Leave the carton unopened in such a case and leave it in the room for more than one hour before opening the carton.

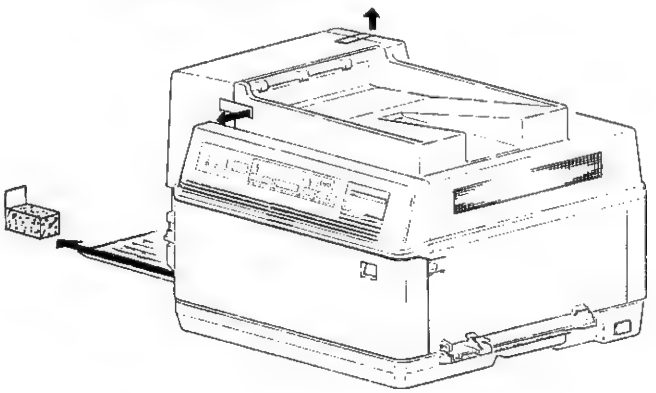
No.	Job description	Check item	Note
1	Place the carton where space is available for opening the package.	Check the carton for damage.	Two persons are required to move the carton as its weight is 22kg 48.5 lbs.
2	Remove taping on the top part of the carton and open the top flap.		
3	Remove the top padding and take out the accessory and supply containing package.	The following accessories and supplies are included. • AC cord • Cassette • Operation manual • Developer cartridge • Toner cartridge and toner collecting container	
4	Remove the top cushion.		
5	Take out the printer.		See Paragraph 2) for the installation procedure.

Carton breakdown view

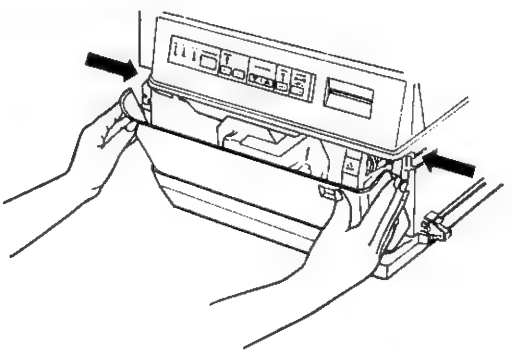


2) Installation procedure

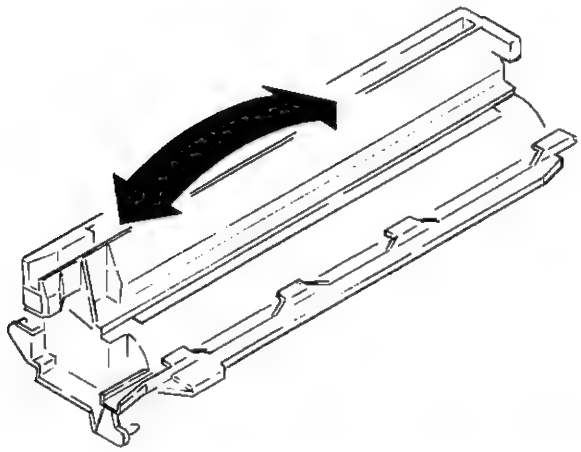
① Remove the poly bag and tapings that secure the facedown cover. The cushion held by the tape under the facedown cover needs to be removed.



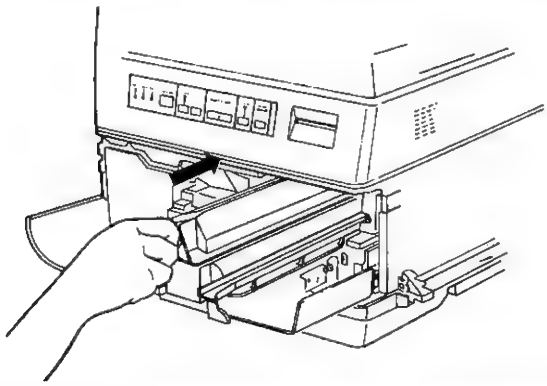
② Open the front cover.
Push the front cover open buttons located at both sides of the printer.



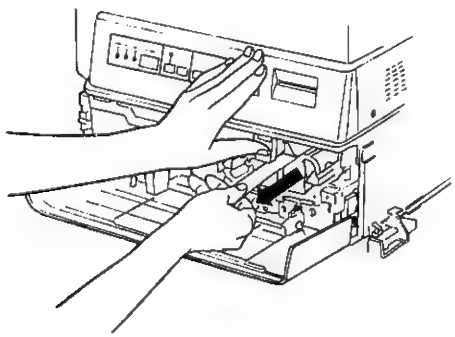
③ Take out the developer cartridge from the bag and shake the developer cartridge holizontally four on five times to make developer level even.



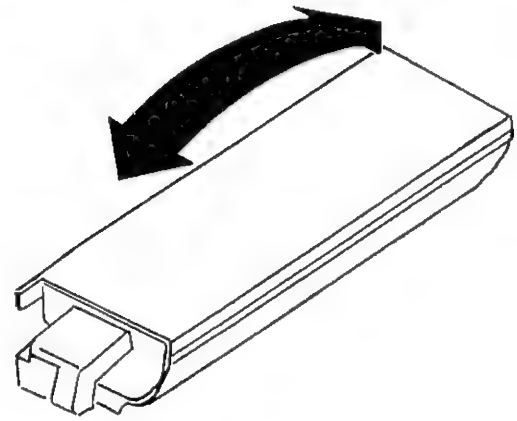
④ Insert the developer cartridge all the way in, along the developer guide on the bottom right edge.
Make sure that it has been mounted firmly in the frame and locks.

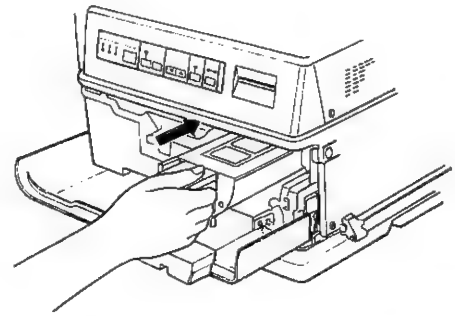


⑤ Pull out the developer sealing tape of the developer cartridge in the arrow direction until it has been completely removed.

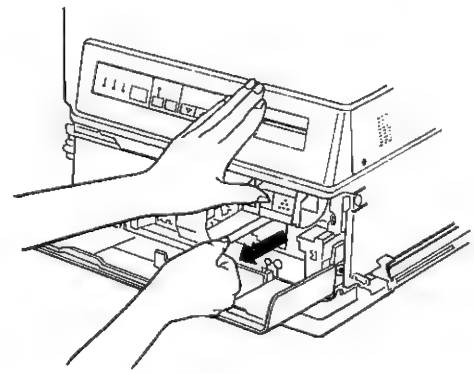


⑥ Shake the toner cartridge on a level for four to five times as shown with arrow marks and install the toner cartridge in the developer cartridge. Insert it all the way in and make sure that the latch of the toner cartridge is firmly engaged.

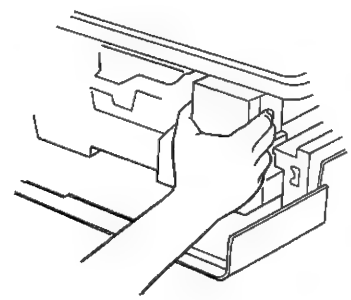




⑦ Pull out the TN seal of the toner cartridge in the arrow direction until it has been completely removed.



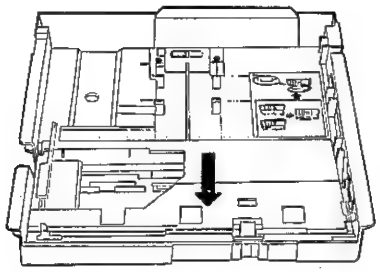
⑧ Insert the toner collecting container all the way until the hooks of the container are firmly engaged.

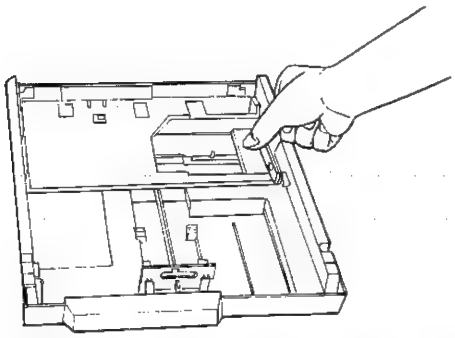


⑨ Close the front cover.

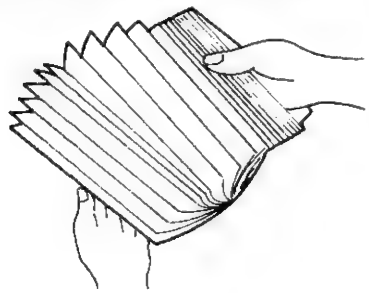
⑩ Take out the cassette from the bag and load sheets of paper on it.

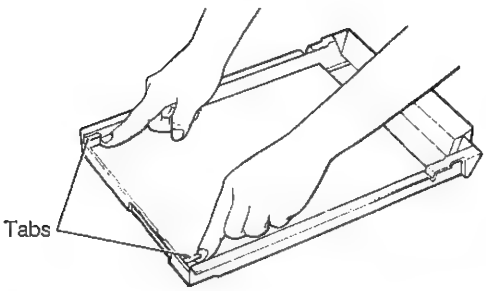
a. Match the adjustable size plate to the size of paper used and push down the paper lifter plate.



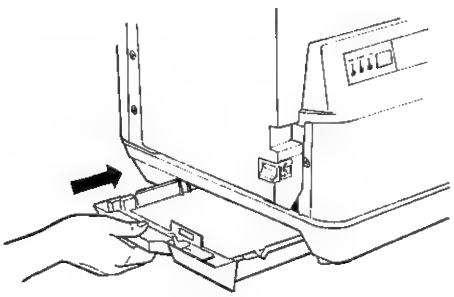


b. Well separate the sheets of paper and set the cassette pawls over the sheets as shown in the figure below.





⑪ Load the cassette in the printer. Push it in all the way in.



⑫ Connecting the AC cord.

a. Make sure before connecting the power cord that the printer main switch is off.

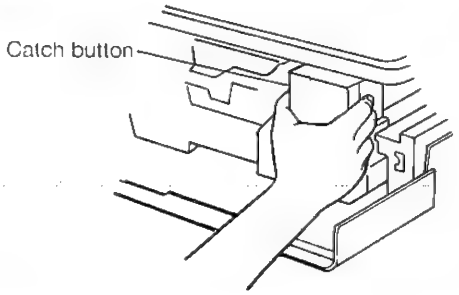
b. Connect the power supply cable to the printer first then to the wall outlet.

⑬ Turn power on.
The green READY lamp will come active after a while and the printer is ready for operation.

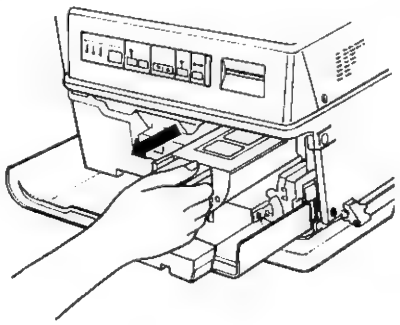
3. Replacing the drum cartridge

① Turn power off and open the front cover.

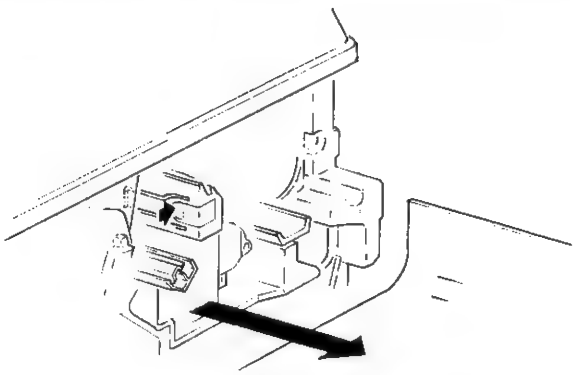
② Push the catch button and take out the toner collecting container.



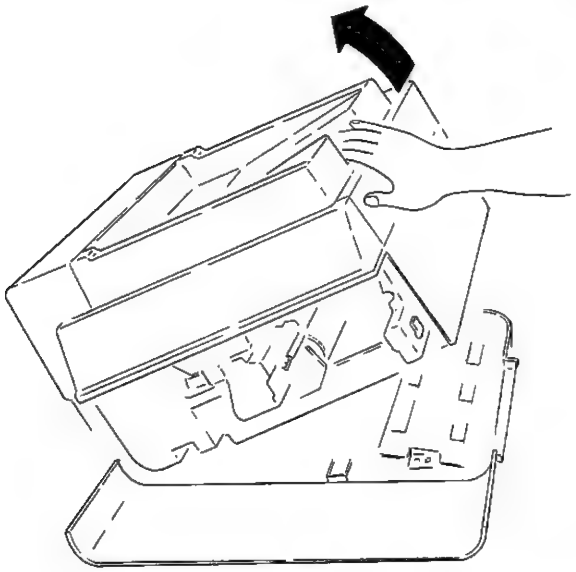
③ Hold the knob of the toner cartridge with your hand and take it out on the front frame side.



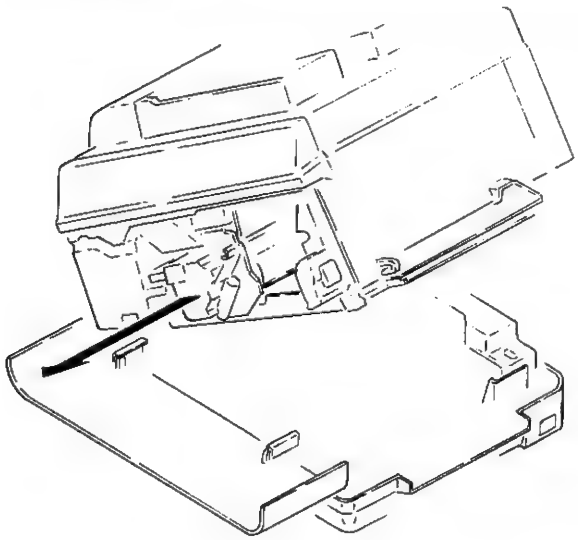
④ Push the catch button and take out the developer cartridge onto the front frame side.



⑤ Push the shell open buttons to open the shell. Use your hand to guide the shell open.

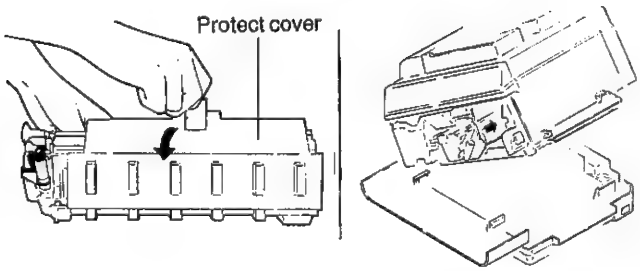


⑥ Grasp the handle of the drum cartridge and take it out the front frame side.



NOTE: Note that the drum cartridge may not be removed or inserted unless the front frame is open.

⑦ Remove the protect cover from a new drum cartridge.



⑧ Push the drum cartridge all the way in until it hits the rear frame, then close the upper frame.

⑨ Insert the developer cartridge, then close the front cover.
The surface of the drum is susceptible to optical fatigue, it has to be replaced in the quickest time possible. Do not touch the drum surface with your finger as it is likely to cause damage or smear in the print.

NOTE: When the drum cartridge is removed from the main body, it must be completely covered by paper for prevention against damage and photo deterioration.

When the drum cartridge is replaced with a new one, execute user diag 04 to initialize the drum counter.

4. Replacing the developer cartridge

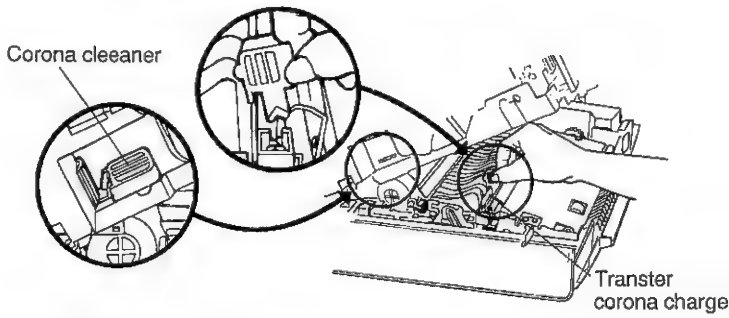
The developer cartridge must be inserted according to the installation procedure.

5. Cleaning the Corona Wires

If the printouts are blotchy or streaky, dirty corona wires may be the cause.

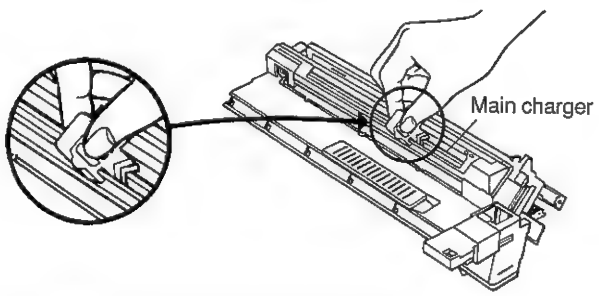
Transfer corona charger

1. Turn off the power.
2. Open the front cover and press the upper half release button to open the upper half of the Laser Printer.
3. Remove the corona cleaner from the machine and clean the transfer corona wire first.



Main charger

1. Carefully pull out the toner cartridge and developer cartridge.
2. Carefully pull out the photoconductor cartridge.
3. Clean the corona wire with the corona cleaner.



4. Reinstall the photoconductor cartridge, developer cartridge, and toner cartridge and close the Laser Printer.

[4] SUPPLIES

1. Kinds of papers

Standard Papers

- Automatic Feeding from the Paper Cassette

Sizes			
Inch series	Invoice 8-1/2″ × 5-1/2″	Letter 8-1/2″ × 11″	Legal 8-1/2″ × 14″ (optional cassette required)
AB series	A5 148 × 210 mm	B5 182 × 257 mm	A4 210 × 297 mm
Weights	16 lbs. 60 g/m² ⟷		21 lbs. 80 g/m²

- Manual Feeding

Sizes	Same as automatic feeding
Weights	16 lbs. (60 g/m²) ⟷ 34 lbs. (130 g/m²)

*Papers with weights from 21 lbs. (80 g/m²) to 34 lbs. (130 g/m²) can be used only with face up output. (The optional face up tray is needed to collect the paper.)
*8-1/2″ × 11″ (A4) is the maximum size for paper weighing more than 28 lbs. (105 g/m²)

Special Papers

	Transparency film	(manual feed and face up paper output only)
Sizes	Letter (8-1/2″ × 11″)	A4

*Use transparency films with backing paper.
*These papers can be used only with face up output. (The optional face up tray is needed to collect the paper.)

Do not use the following kinds.

1. Paper not mentioned above.
2. Surface coated paper
3. Paper with crease, scratch, stapled, perforation.

2. Photoconductor cartridge, developer cartridge, toner cartridge, toner collecting container.

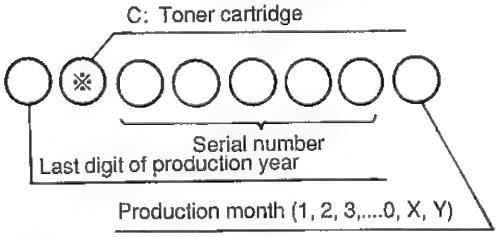
	Name	Description	Product name	Pcs/pack	Life	Storage period
1	Photoconductor cartridge	Photoconductor cartridge x 1 Instructions x 1	JX-93DR	5	*1	24 months after the production month (not unpacked) (Condition) Humidity: 10~90% Temperature: –10~40°C
2	Developer cartridg	Developer cartridge x 1	JX-93DC	5	*2	
3	Toner kit	Toner collecting container x 1 Toner cartridge x 1	JX-93TC	5	*3	

*1: Maximum print life is 30,000 pages.
*2: Maximum print life is 10,000 pages.
*3: A4 (8-1/2" x 11"), 4% black image area, 5,000 pages

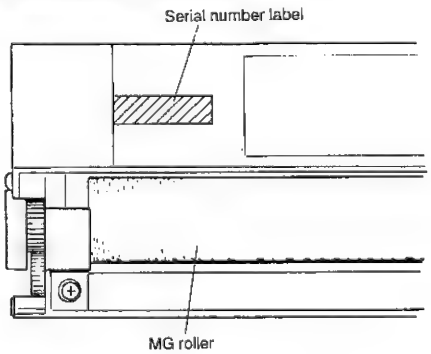
NOTE: How to identify the lot number

(Developer cartridge)

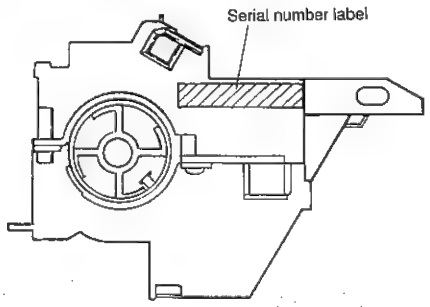
A: Photoconductor cartridge
B: Developer cartridge
C: Toner cartridge



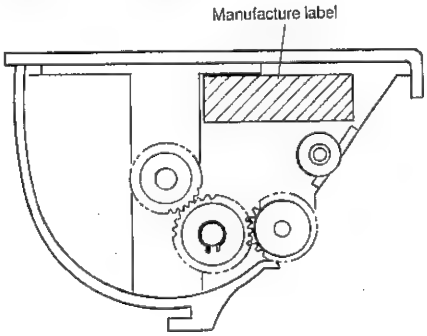
Developer cartridge rear frame side



Photoconductor cartridge rear frame side

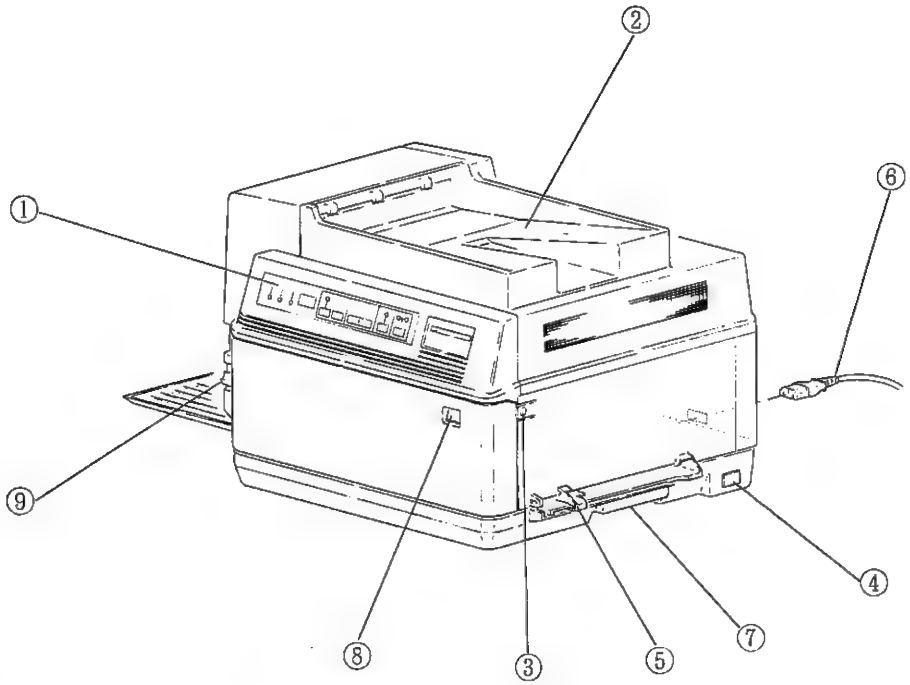


Toner cartridge rear frame side



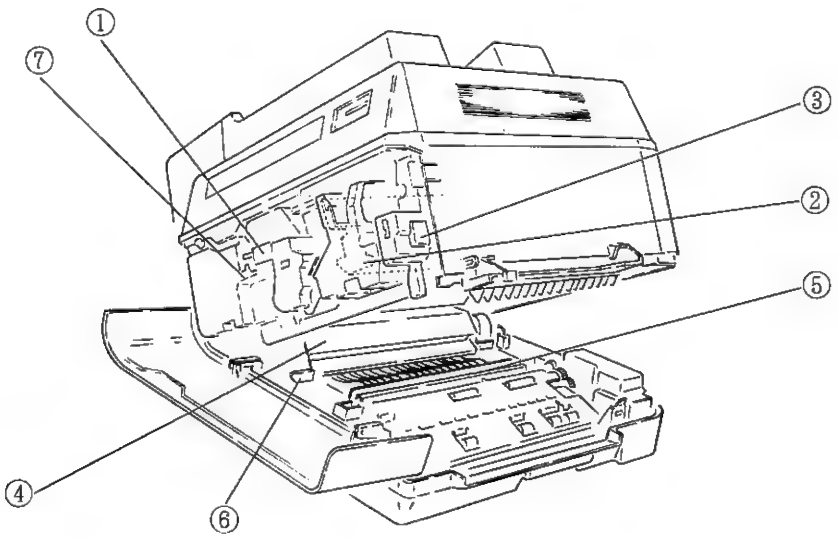
[5] OUTLOOK AND INTERNAL STRUCTURE

1. Outlook



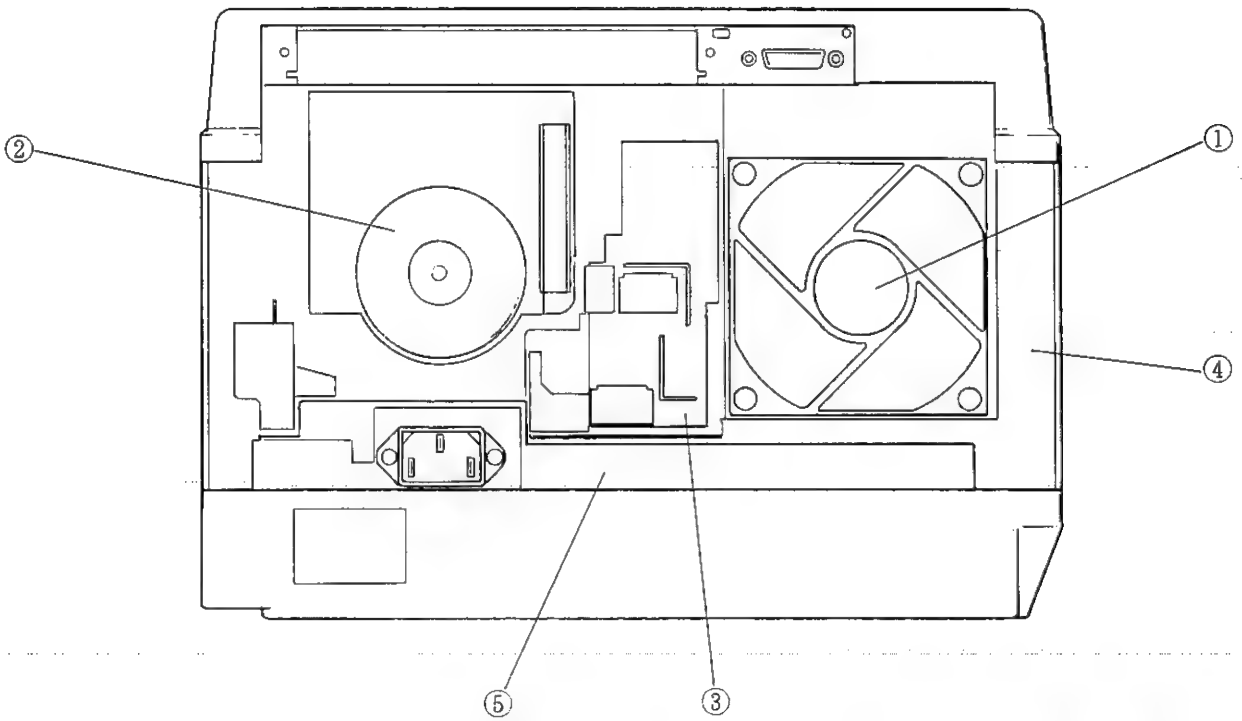
①	Operation panel	②	Facedown tray	③	Front cover release button (paper entry side)
④	POWER switch	⑤	Manual feed guide	⑥	Power supply cord
⑦	Carry handle (paper entry side)	⑧	Toner cartridge check window	⑨	FD mode switch

2. Open view



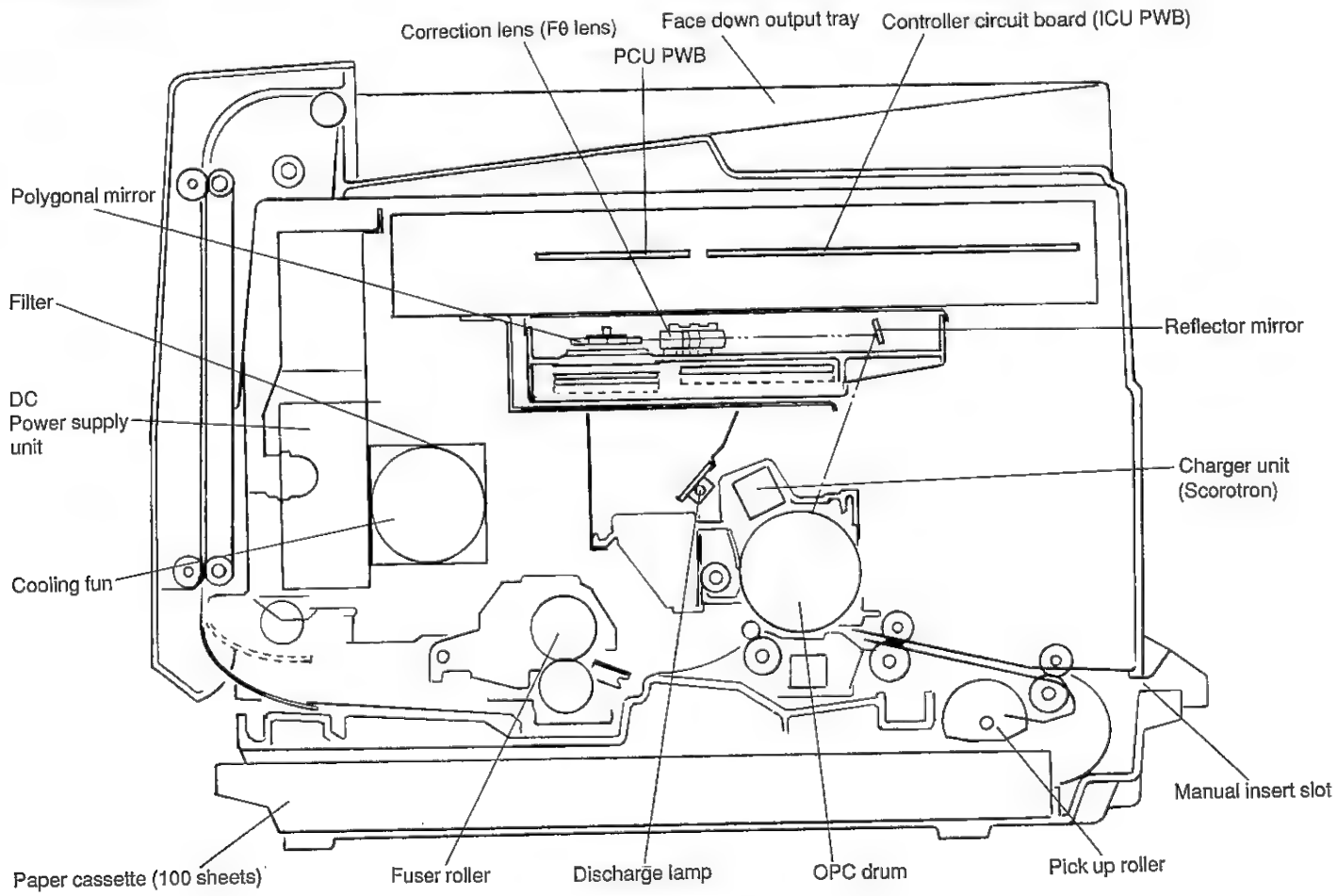
①	Photoconductor cartridge	②	Developer cartridge	③	Upper half release button
④	Fuser unit	⑤	Transfer corona unit	⑥	Fuser accessing knob
⑦	Transfer corona cleaner				

. Rear frame side



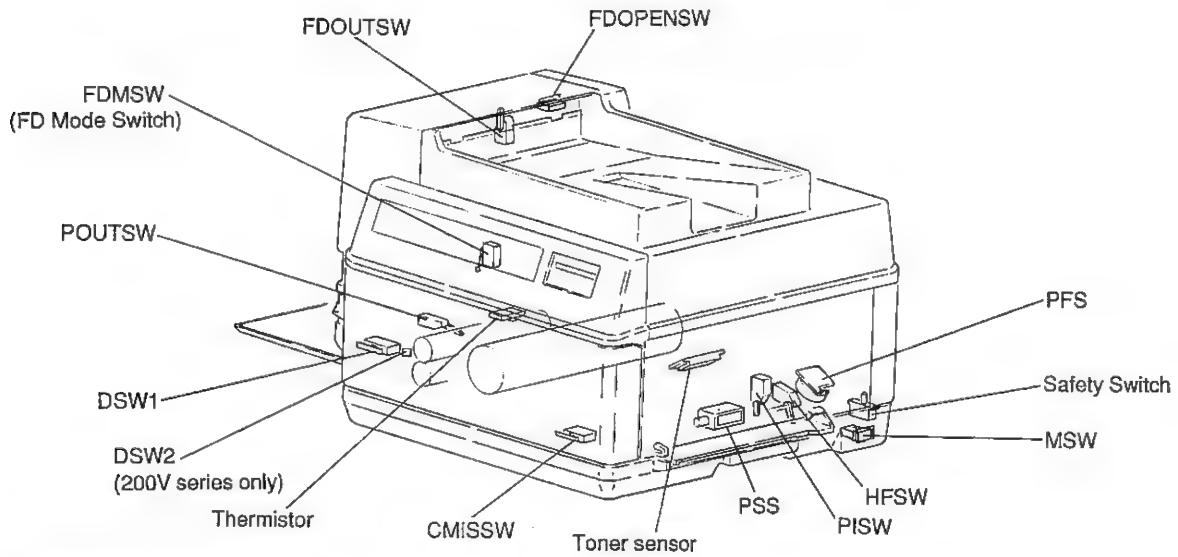
①	Fan motor	②	Main motor	③	High voltage transformer unit
④	DC supply unit	⑤	AC supply unit		

4. Cross section



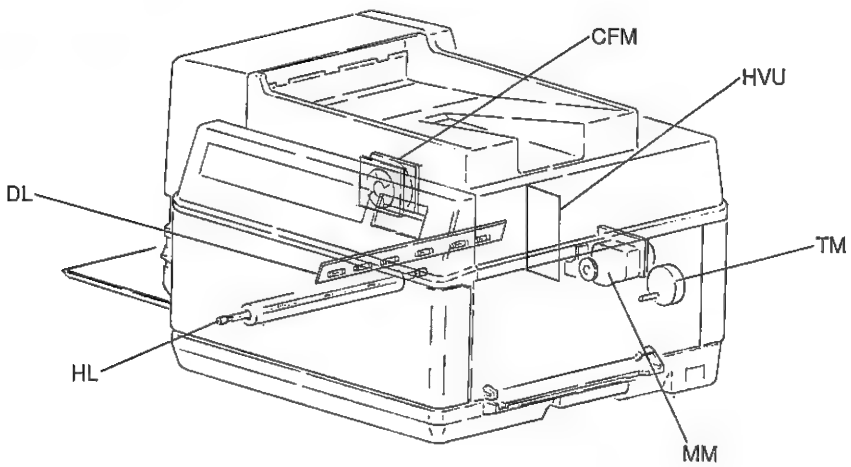
5. Switch, sensor, solenoid locations

Name	Type	Function
PISW	Switch	Paper entry sensor
POUTSW	Switch	Paper exit sensor
HFSW	Switch	Manual feed paper entry sensor
DSW1	Microswtich	Door open sensor
DSW2	Microswitch	12V line safety switch
FDOPENSW	Microswitch	24V line safety switch
MSW	Switch	POWER switch
CMISSW	Microswitch	Checks presence of the toner collecting container (the machine would not start because power is not supplied to the main board, if the toner collecting container was not installed in the printer).
Toner sensor	Magnetic sensor	Toner concentration sensor
Thermistor	Thermistor	Upper heat roller surface temperature sensor
PFS	Solenoid	Cassette paper feed solenoid
PSS	Solenoid	Paper stop solenoid
FDOUTSW	Switch	Paper exit sensor for face down tray



6. Motor, transformer, lamp locations

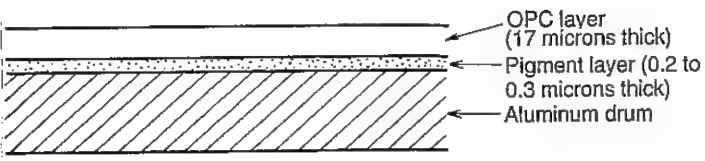
Symbol	Name	Function
MM	Main motor	Load drive motor.
TM	Toner motor	Toner supply motor
HVU	High voltage units	Main corona and transformer corona high voltage supply units
DL	Discharge lamp	For removal of residual charge on the drum surface
HL	Heater lamp	For heat roller heating
CFM	Cooling fan motor	Cooling, Ventilation



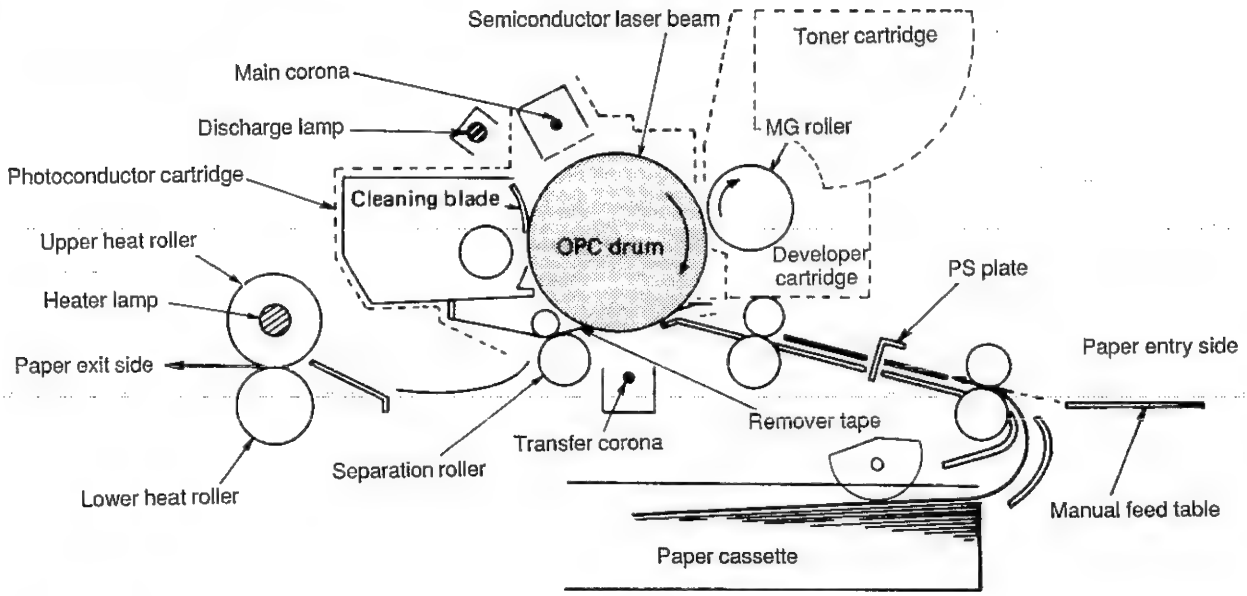
[6] PRINT PROCESS

An OPC drum is used for the photoconductor.

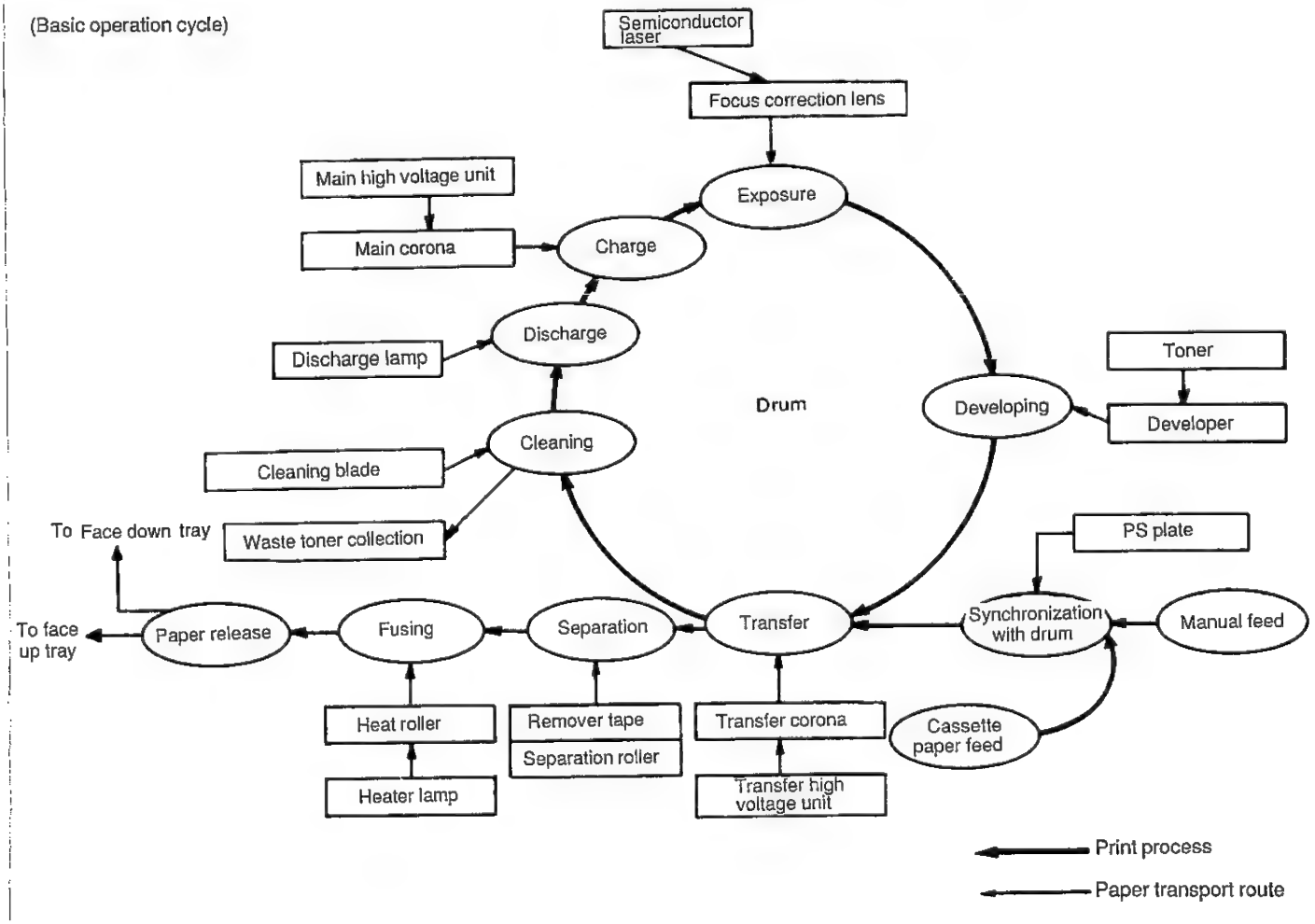
(Structure of the OPC drum layers)



1. Functional diagram



(Basic operation cycle)



2. Image forming process steps

The JX-9300 is a non-impact printer that uses the semiconductor laser and electrostatic print process and uses an OPC (Organic Photo Conductor) for its photoconductive material. First, corona from the main corona unit charges the drum surface and a latent image is formed on the drum surfacing using a laser beam. This latent image forms a visible image on the drum surface with toner. The toned image is then transferred onto the print paper by the transfer corona and fixed on the print paper using the fuser roller, and pressure.

Step-1: Optical discharge
Residual charge on the drum surface is removed.

Step-2: Charge
Charge the drum surface uniformly.

Step-3: Exposure
Latent image is formed on the drum.

Step-4: Developing
Latent image formed on the drum is then changed into visible image with toner.

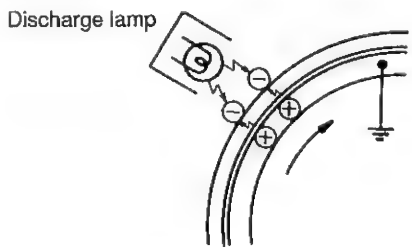
Step-5: Transfer
The visible image (toner image) on the drum is transfered onto the print paper.

Step-6: Cleaning
Residual toner on the drum surface is collected by the cleaning blade.

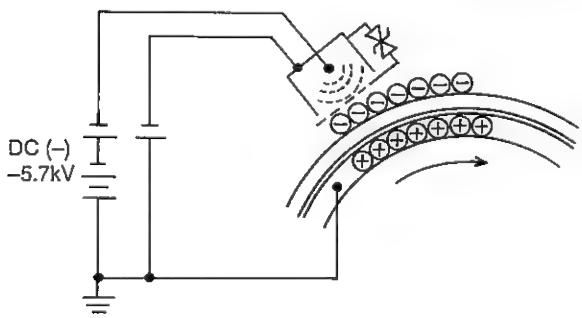
Step-7: Optical discharge
Residual charge on the drum surface is removed.

3. Basic print process

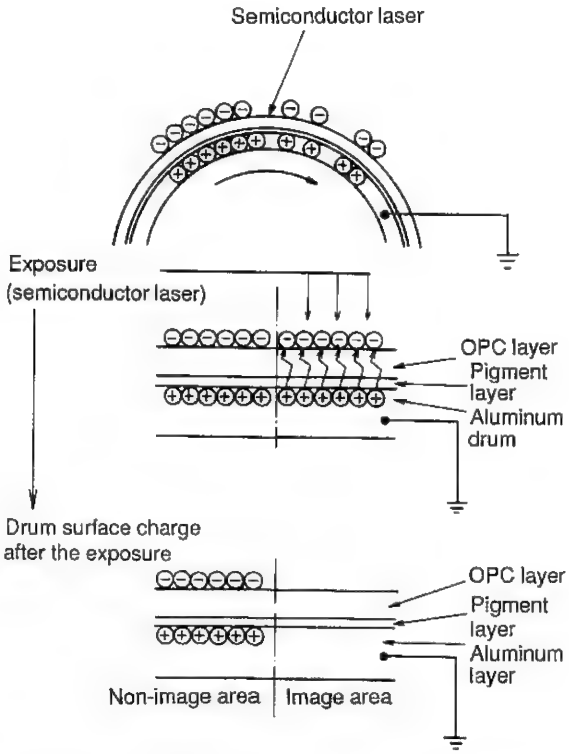
Step-1: Optical discharge (by the discharge lamp)
Prior to charge, light from the discharge lamp is projected over the drum to reduce electrical resistance of the OPC layer and to remove the residual charge to evenly neutralize the drum surface. As the electrical resistance is decreased, the positive charge in the aluminum layer moves to neutralize the negative charge present in the OPC layer.



Step-2: DC charge
A uniform negative charge is applied over the OPC drum surface by the negative discharge from the main corona unit. Stable potential is maintained by means of the Scorotron charger.



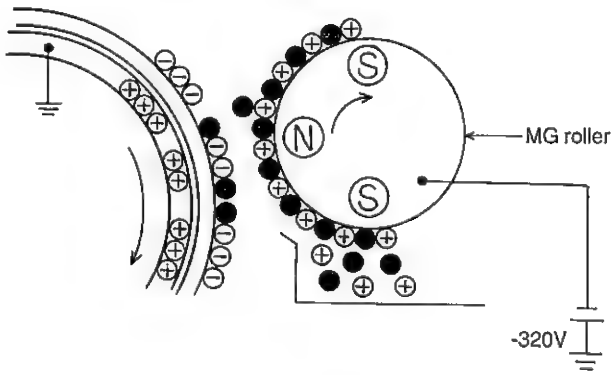
Step-3: Exposure (laser beam, mirror, lens)
A Laser beam is generated from the semiconductor laser with the print pattern signal. It is exposed onto the OPC drum surface through the mirror and lens. The resistance of the OPC layer decreases for an area exposed by the laser beam (corresponding to the print pattern signal). The beam neutralizes the negative charge. The electrostatic latent image is formed on the drum surface.

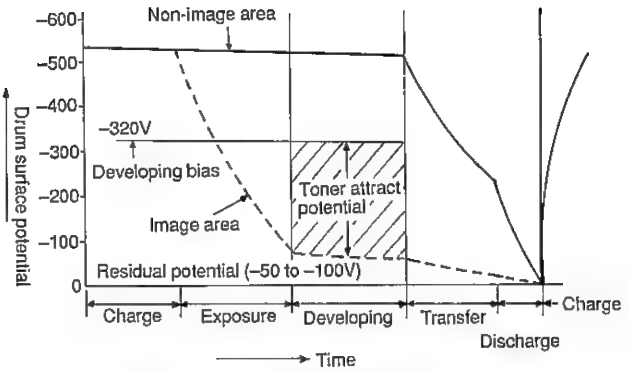


Step-4: Developing (-320V bias)
The electrostatic latent image in the drum surface is converted into a visible image by the toner. A bias potential of -320V is applied to the carrier (MG roller) in the two component magnetic brush developing method, and the toner is charged negative through friction with the carrier.

Non-image area of the drum surface charged with negative potential repel the toner, whereas the bright exposed portions where there are no negative charges exist are developed by the toner. As a result, a visible image appears on the master surface.

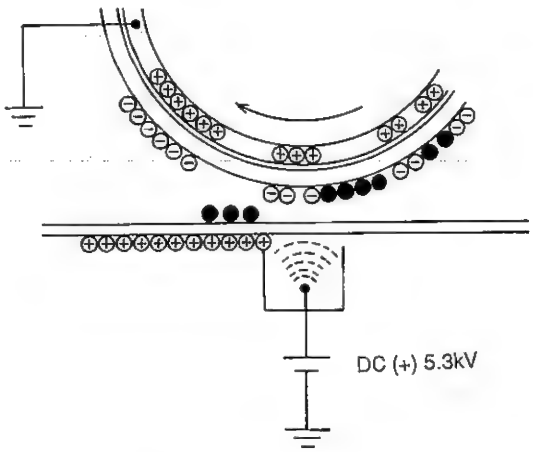
○ : Carrier (magnetized particle)
● : Toner (charge negative by friction)
(N) (S) : Permanent magnet
(provided in three locations)



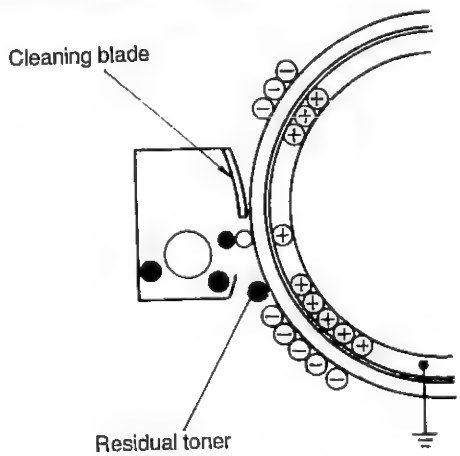


Toner is attracted over the shadowed area because of the developing bias.

Step-5: Transfer
The visible image on the drum surface is transferred onto the print paper by applying a positive charge from the transfer corona to the back of the print paper.



Step-6: Cleaning
Toner remaining on the drum is collected by the cleaner blade and stored in the toner collecting container.



Step-7: Discharge (same as Step-1)

Charge by the Scorotron charger

Function
The Scorotron charger functions to maintain the surface potential of the drum even at all times which can be used to control the surface potential regardless of the charge characteristics of the photoconductor.

Basic function
A screen grid is provided between the corona wire and the photoconductor, a stable voltage is added to the grid to apply the corona current to the photoconductor and the grid.

As the photoconductor is charged by the corona from the main corona unit, the surface potential increases. This increases the current flowing through the screen grid. When the photoconductor potential nears the grid potential, the entire current turns to flow to the grid so that the photoconductor potential can be maintained at a stable level.

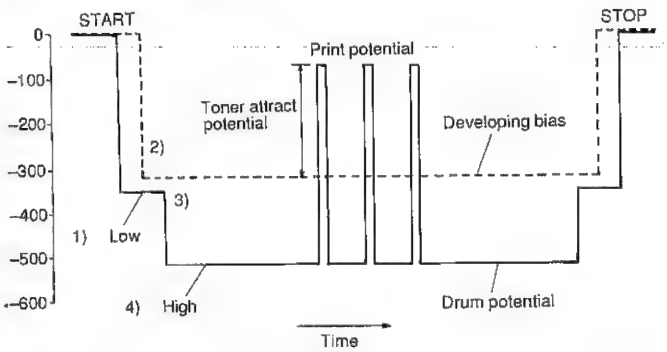
Process controlling

Function
Print pattern signal is converted into a visible image by the semiconductor laser using negative to positive (reversible) developing method. Therefore, if the developing bias is added before the drum is charged, toner is attracted onto the drum. If the developing bias is not added when the drum is charged, the carrier is attracted to the drum because of a strong electrostatic force of the drum.

To avoid this, the process is controlled by adjusting the drum potential and the grid potential of the Scorotron charger.

Basic function
Voltage added to the screen grid can be selected, high and low.

To make it easily understood, the figure below shows voltage transition at the developer unit.



Start
1) Because the grid potential is at a low level, the drum potential is at about −350V. (Carrier may not be attracted though the carrier is pulled towards the drum by the electrostatic force of −350V.
2) Developing bias of −320V is added when the drum potential is at a low level (about −350V).
3) Even if the −320V developing bias voltage is added, toner deposit will not occur because there is a voltage difference of 30V between the drum potential (−350V).
4) After the developing bias (−320V) is added, the grid voltage changed from low to high, but the toner and developer may not be attracted because the drum potential at high stage is about −520V.

Stop
The reverse sequence takes place.

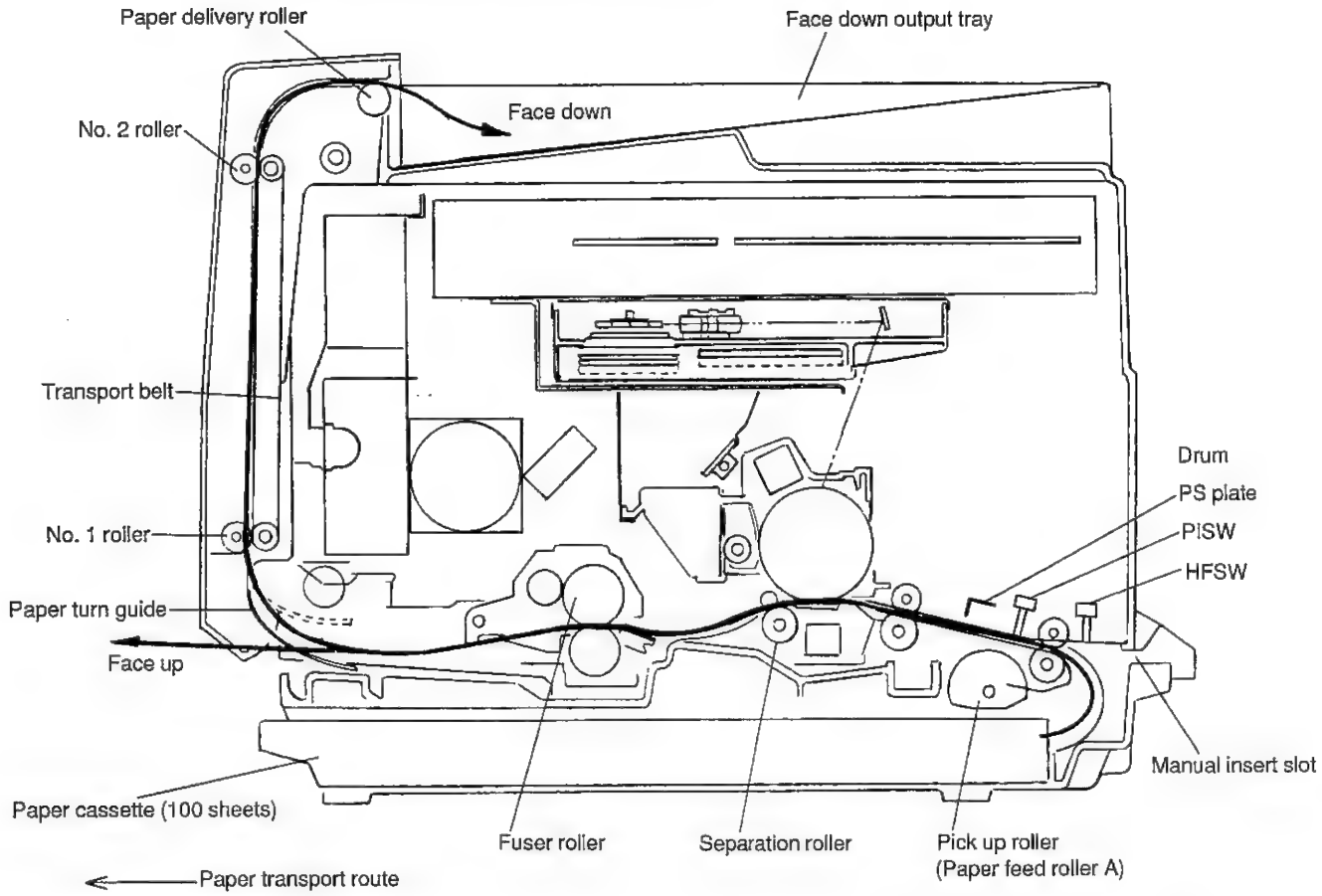
Retaining developing bias at an abnormal occurrence

Function
The developing bias will be lost if the power supply was shut off during printing due to a power supply failure. In this event, the drum potential slightly abates and the carrier makes deposits on the drum because of strong static power. To prevent this, the machine incorporates the function to retain the developing bias for a certain period against a possible power supply failure.

Basic function
Normally, the developing bias voltage is retained for a certain time before the drum comes to a complete stop, if the machine should stop before completing the normal print cycle. In this way, the developing bias can be added before resuming the operation after an abnormal interruption. No carrier will therefore make a deposit on the drum surface.

[7] PAPER FEED AND TRANSPORT SECTION

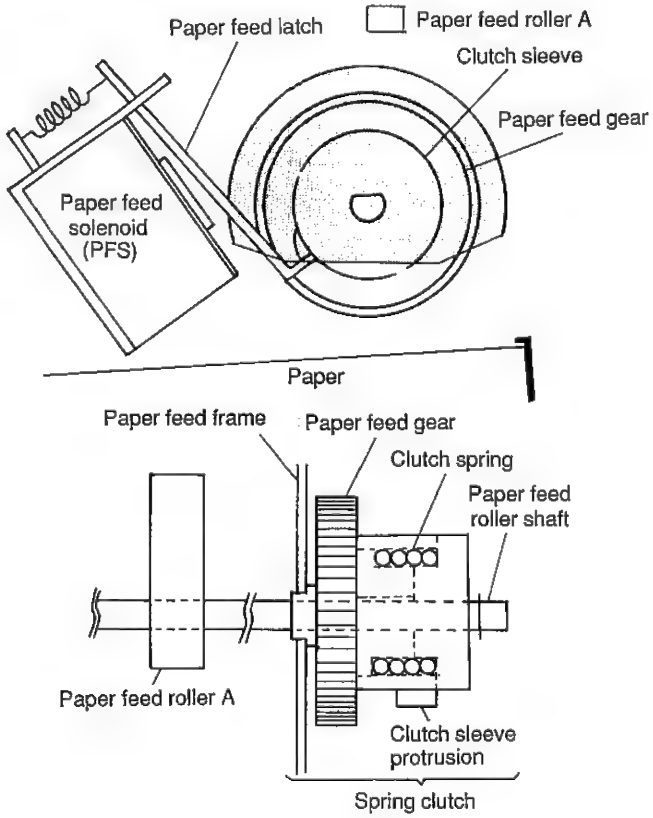
1. Paper transport route and operational description



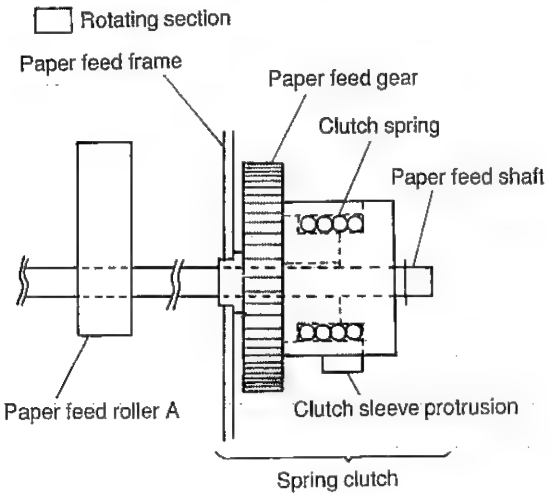
A. Operation during cassette feed

The following discusses the cassette feed and manual feed operations.

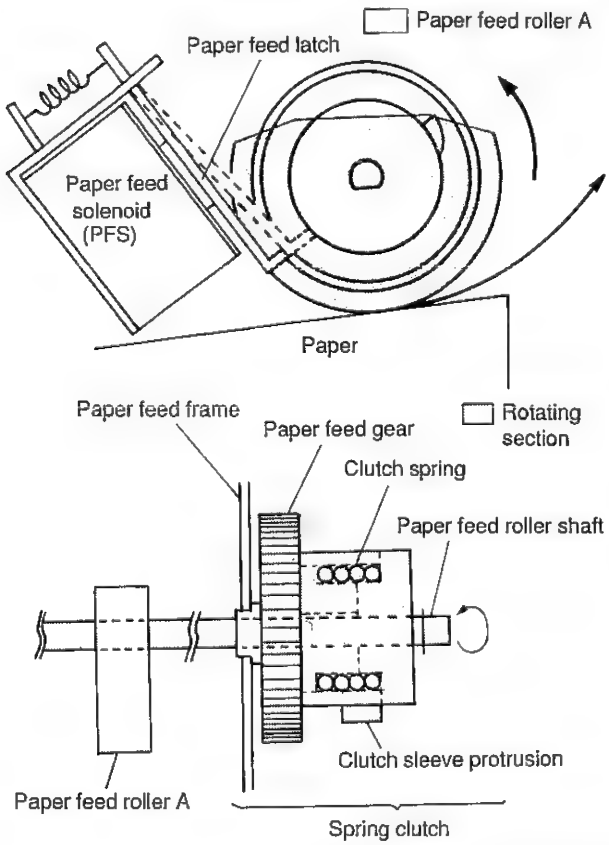
① The illustration below shows the relation among the paper feed roller A, paper feed clutch sleeve, and the paper feed latch locations when the printer is at an initial state before the PRINT switch is pressed after the actuation of the READY lamp.
The paper feed latch is in contact with the clutch sleeve protrusion.



② At the moment the PRINT switch is pressed, the drive motor starts to run the drive gears. The paper feed gear also starts to be driven, but the rotation of the gear is not conveyed to the paper feed roller shaft and therefore the paper feed roller does not rotate because the paper feed latch is holding the clutch sleeve protrusion.

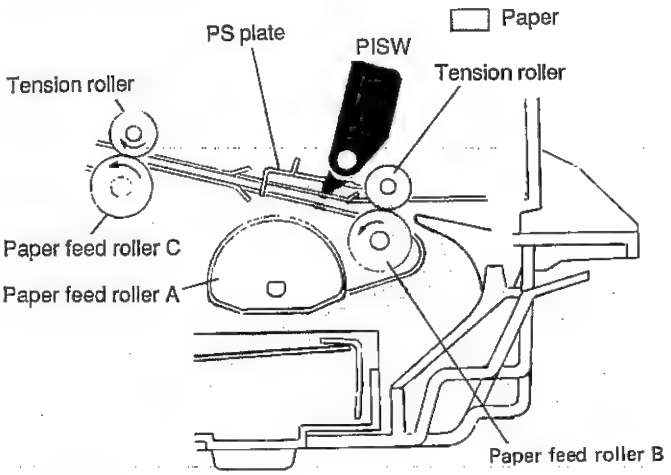


③ In 0.9 second after the start of the main motor, the paper feed solenoid (PFS) actuates momentarily so that the paper feed latch disengages from the clutch sleeve protrusion. Then, the rotation of the paper feed gear is conveyed to the paper feed roller shaft so that the paper feed roller A starts rotating to feed the paper.

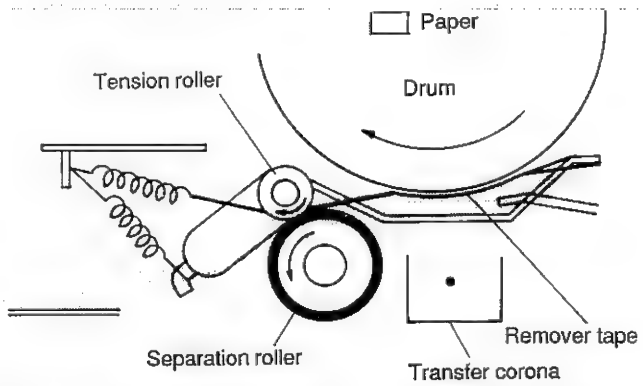


④ As the paper feed roller A makes a full turn, the clutch sleeve protrusion is caught by the paper feed latch so that the paper feed roller A stops rotating.

⑤ The paper fed further into the machine is transported to the PS plate through the paper feed roller B and the paper entry sensor (MS1). There, the paper is stopped temporarily by means of the PS plate, in order to synchronize with the top edge of the image on the drum. Since the paper feed roller B is continuing to rotate, the paper lead edge is evenly pressed against the PS plate to correct a paper feed skew.



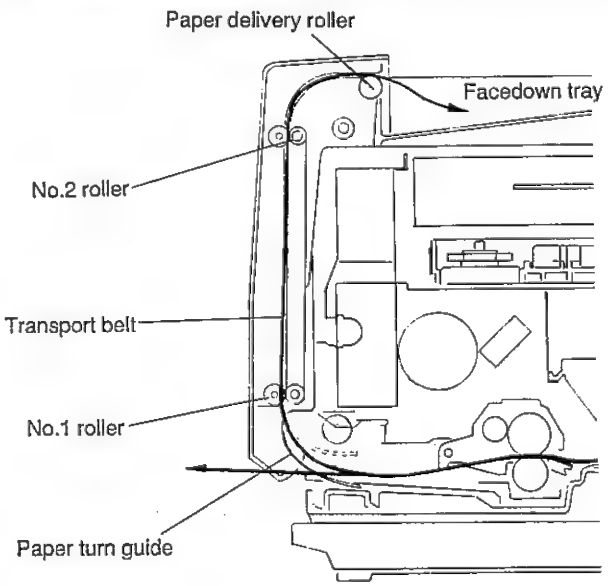
⑦ After the PS plate has been released, the paper is transferred to the transfer unit via the paper feed roller C. The paper transferred with the image is separated from the drum by the remover tape and the separation roller.



⑧ The paper separated from the drum passes through the fuser paper guide, fuser heat roller, and the paper exit sensor (POSW)

⑨ The paper passed over POSW is released as it is in the faceup mode. In the case of the facedown mode, the paper is transported to the number one roller along the paper turn guide.

⑩ The paper is transported to the number two roller and released onto the facedown tray by means of the paper delivery roller.



B. Operation during manual feed

① When paper is inserted in the manual insert slot HFSW is actuated and the main motor starts to turn the drive gears.

The paper inserted is then taken up by paper feed roller B. the reset of the copy paper operation is identical to the cassette feed operation described in: (A-⑤~⑩)

2. Adjustments

A. Paper feed roller A location (angle)

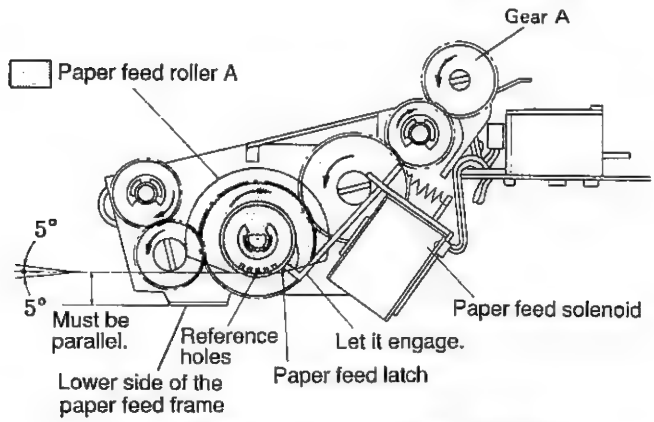
Adjustment is required for any of the following reasons:

- When a misfeed occurred in the paper feed block.
- After disassembly or replacement of a component.

(Check procedure)

① Remove the paper feed unit from the printer (2-A-①).

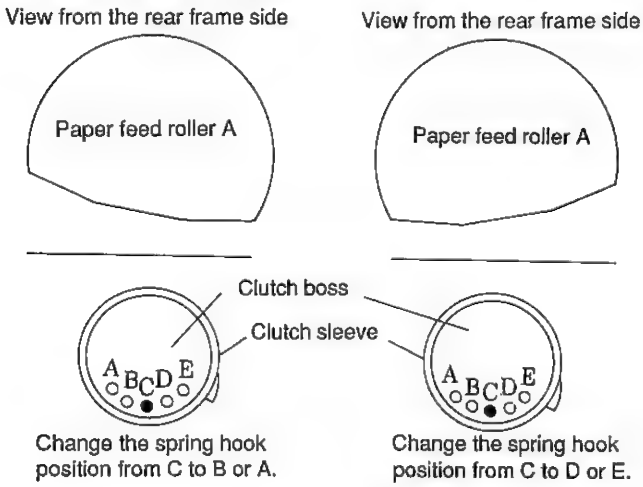
② Turn the gear in the arrow direction and have the clutch sleeve protrusion come into contact with the paper feed latch. Make sure that the lower side of the paper feed roller A is parallel to the lower side of the paper feed frame. The tolerance is 0±5°.



(View of the paper feed unit from the rear frame side)

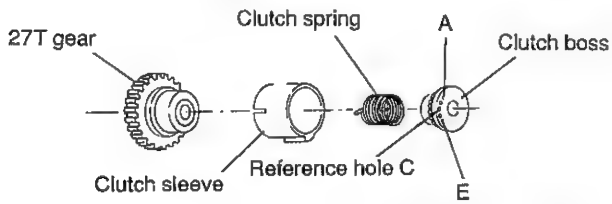
① Check deviation in the paper feed roller A.

② Change the hook position of the clutch spring according to the degree of angular deviation.



②-a. Remove the spring clutch assy (C-③-a).

②-b. Disassemble the spring clutch assy and change the hook position of the spring.

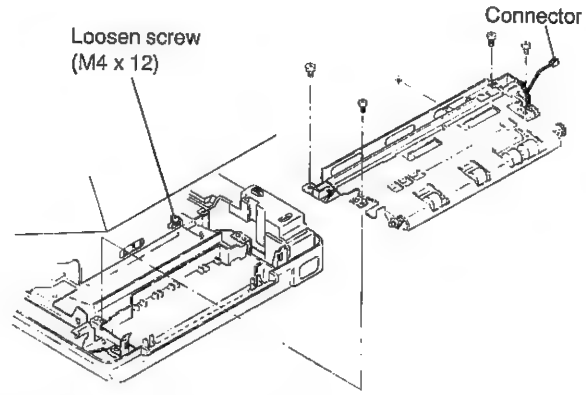


* After the clutch was disassembled, the clutch spring needs to be lubed with grease (UKOG-0062FCZZ).

3. Major component removal and replacement

A. Paper feed unit

① Open the frames. Unfasten the paper feed solenoid connector and remove the paper feed unit holding screws. Take out the paper feed unit. Remove four screws (M4 x 10) out of five and leave the remaining one (M4 x 12) loosened.



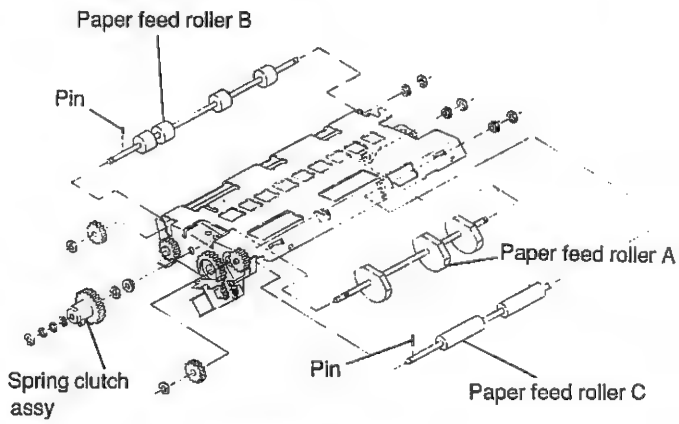
a. Paper feed roller, A, B, C

① Remove the paper feed unit (A-①).

② Remove the E-ring, spring clutch assy, and bushing. Remove the paper feed roller A. Adjustment is required when replacing.

③ Remove the E-ring, gear, pin, and bushing. Remove the paper feed roller B.

④ Remove the E-ring, gear, pin, and bushing. Remove the paper feed roller C.



b. Corona wire replacement

① Remove the paper feed unit (A-①).

② Loosen the TC holder F corona wire holding screw (M3) and remove the corona wire.

③ Remove the TC holder R holding screw (M3) and remove the TC holder spring.

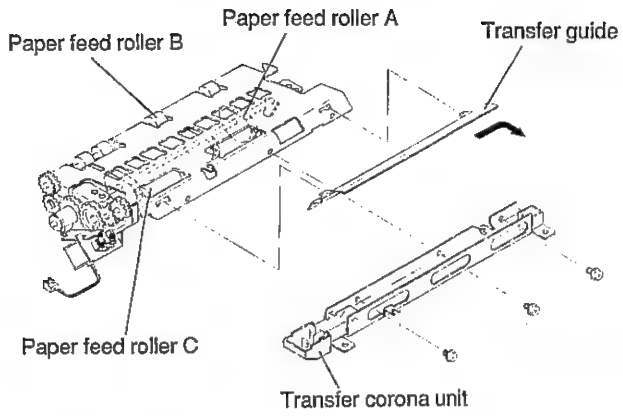
④ Install a new corona wire to the TC holder spring (DWIR-0466FCZZ). Make more than ten turns to prevent the corona wire from loosening.

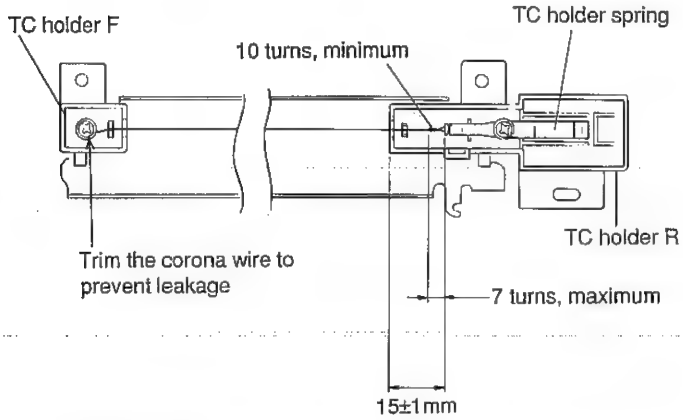
⑤ Install the TC holder spring to the TC holder R and hold it with the screw (M3).

⑥ Stretch the corona wire so that there is a clearance of 14 to 16mm between the edge of the TC holder spring and the TC holder R peripheral, and make turns of the wire around the screw and fasten the screw.

* Pay special attention not to break the corona wire when stretching.

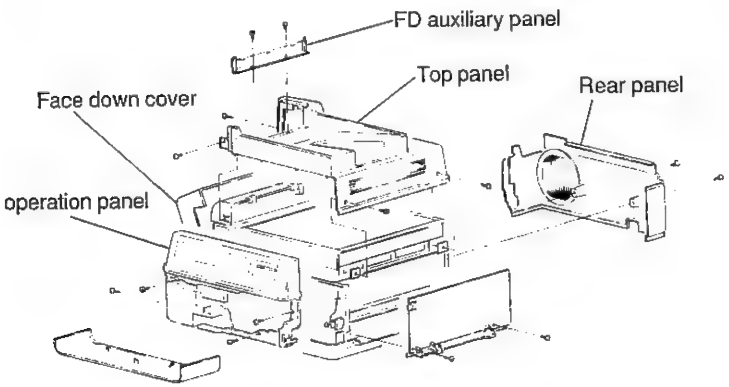
⑦ After securing the corona wire, wipe it clean with isopropyl alcohol.





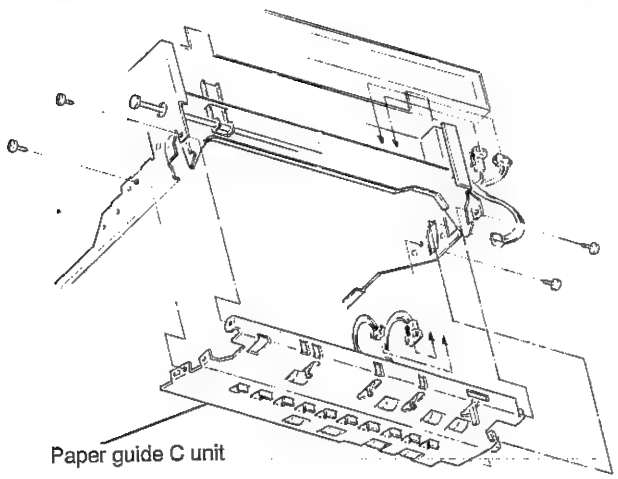
B. Paper guide C unit

① Open the facedown cover and remove the external panels (FD auxiliary panel, top panel, rear panel, operation panel).



② Remove the connectors.

③ Remove two screws (M3) that are used to secure the upper frames R and F, and remove it down ward.

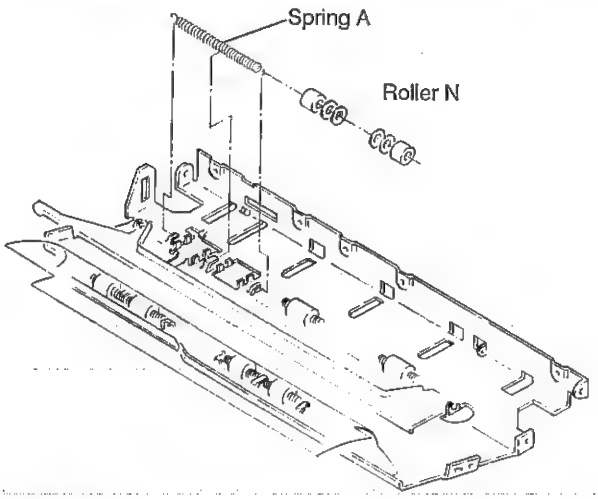


a. Roller N

① Remove the paper guide C roller springs, A, B, and C, from the spring hook.

② Remove roller N and the flat washer from the spring.

Do the reverse sequence to re-install roller N. Each roller spring (A, B, C) must be installed with the opening of the hook facing up. Lube the inner side of roller N with white grease. But, do not smear the roller outside with grease.



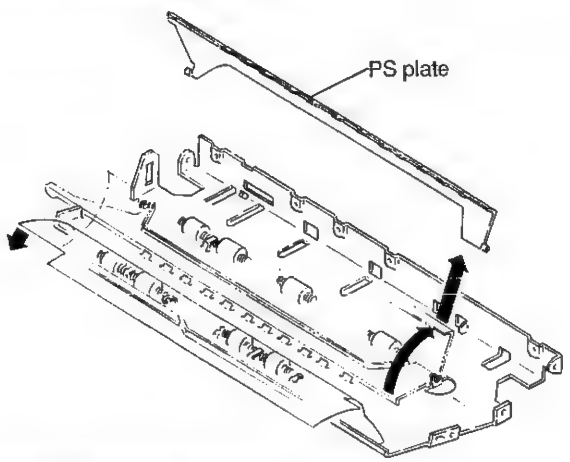
b. PS plate

① Rotate the PS plate to the cut in the PS plate bracket.

② Remove the PS plate through the cut. The PS plate bushing is made of rubber, care must be taken not to damage it.

③ Remove the bushing from the PS plate.

* Note the direction of the protrusion of the bushing when reassembling the bushing to the PS plate.



c. PS solenoid, DV switch, PSS wire

① Unfasten two wiring ties that hold the PS solenoid and DV switch wires. The MOLEX at the center must be cut(*1).

② Remove the M3 tapping screw that holds the PS pulley shaft and remove the PS pulley shaft(*2).

③ Move the PSS wire to the wire inserting hole and remove the PS plate.

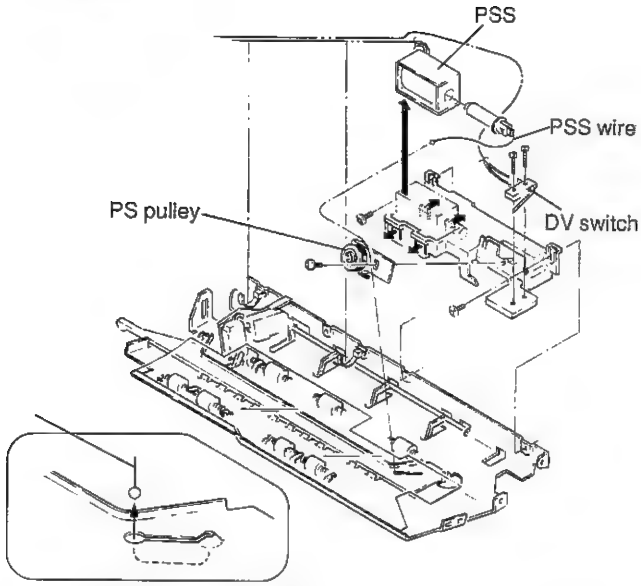
④ Remove two screws (M3) that secure the PS solenoid bracket and remove the bracket from the paper guide C.

⑤ Widen the tab at four locations of the PS solenoid bracket and remove the PS solenoid.

⑥ Remove the PS solenoid plunger and the PSS wire.

⑦ Remove two screws (M2.3) that hold the DV switch, and remove the DV switch from its bracket(*3).

* Note the installing direction of the actuator when replacing the DV switch.



*1: PS solenoid and DV switch wire clamp
Hold the DV switch wires at three locations with clamps on the PS solenoid bracket and the PS solenoid wire at one location. Four wires from the PS solenoid bracket must be secured with a wiring tie at two locations. Wires must be stretched to prevent interfering with the manual feed arm.

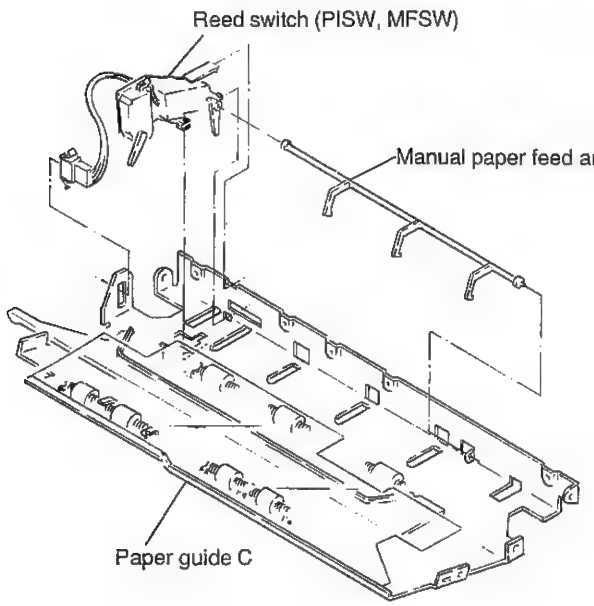
*2: PS wire tension adjustment
With the PS solenoid activated, adjust the PS pulley shaft holding M3 tapping screw so that the clearance between the top end of the PS bracket and the solenoid holding rib of the PS solenoid bracket should be 1.0 to 2.0mm. The PS pulley shaft may shift 2mm up or down. Then, with the PS solenoid inactive and the PS plate at its lower limit, make sure that the clearance between the top end of the plunger and the plunger retainer is 0 to 1mm.

*3: DV switch installing direction
Note the installing direction of the actuator before installing the DV switch.

d. Reed switch

① Unfasten the reed switch connector from the paper guide C.

② Widen the reed switch holding tabs and remove the paper guide C.



C. Gear 18T, gear 18T/39T, gear 50AS, gear 37T, gear 24T

① With the facedown cover open, remove the external panels (FD auxiliary panel, top panel, rear panel, operation panel).

② Unfasten the PS solenoid and DV switch connectors that extend from the paper guide C unit (top frame R paper entry side).

③ Remove two screws from the top panel R and F paper guide C, and lower the paper guide C unit from the rear frame side to remove.

a. Gear 18T

① Pull out the gear 18T towards the front frame side.

b. Gear 18/39T

① Remove the E-ring (E8) from the shaft and remove the gear 18T/39T.

c. Gear 50AS

① Remove the E-ring (E8) from the shaft and remove the gear 50AS.

② Remove the screw (M3) on the back side of the gear 50AS and remove the DR drive spring (*1).

③ Remove the flat rivet (ϕ3, L9)(*2).

*1: To prevent action of the flat rivet, provide an adequate clearance between the shaft escape portion of the DR drive spring and the gear 50T shaft periphery and secure it with the screw (M3), when reassembling.

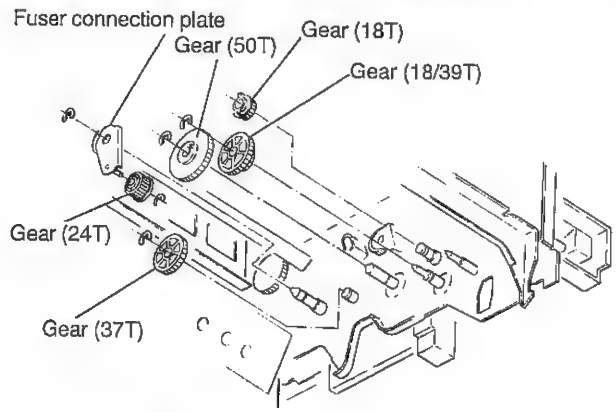
*2: Evenly lube the outer surface of the flat rivet with white grease, when re-assembling.

Pay special attention in handling this gear as it is precision made. Scratch on the teeth surface may lead to an uneven paper feed or to deterioration of print quality.

d. Gear 37T, gear 24T

① Remove the E-ring (E8) from the shaft and remove the fuser connection plate assy and the gear 37T.

② Remove the E-ring (E6) from the gear 24T shaft of the fuser connection plate assy and remove the gear 24T.



D. Facedown stacker

a. Facedown cover assy

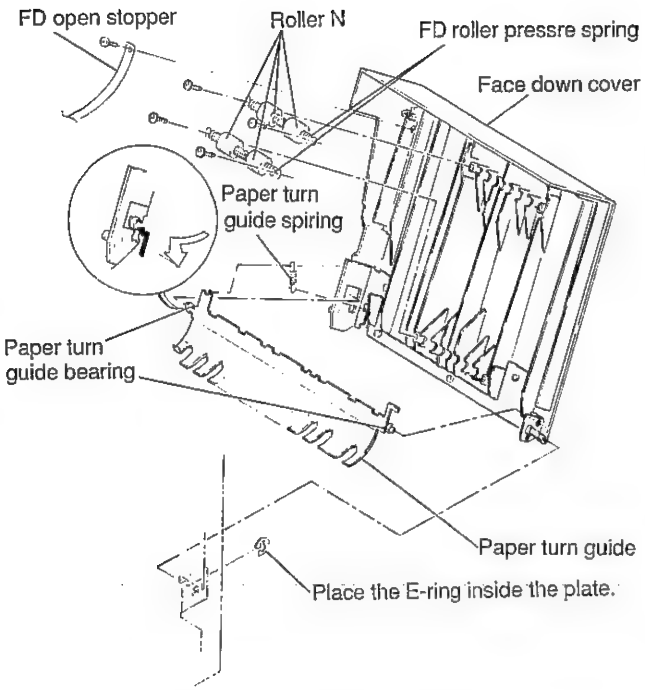
① Open the facedown cover, remove the facedown chassis side screw (M3), and remove the facedown cover open stopper.

② Remove the E-ring (E5) that inserted to the front side shaft of the cover holding plate, move the facedown cover towards the rear side, then remove it from facedown chassis.

③ Remove four tapping screws (M3). Remove two FD roller tension springs and four rollers. Inner side of each roller must be lubed with white grease when replacing.

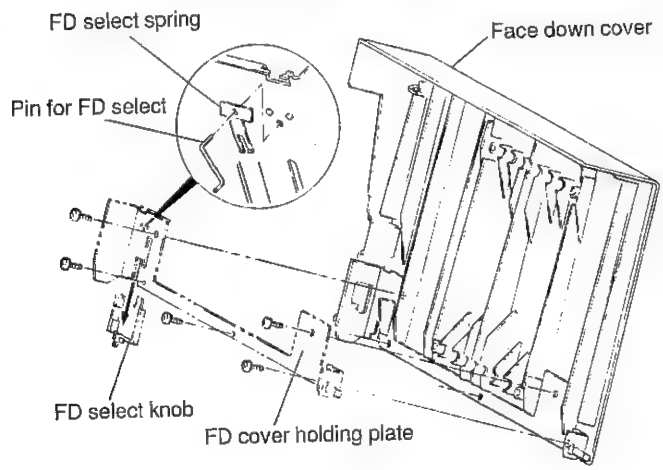
④ Shift the paper turn guide onto the bushing slot on the rear frame side of the cover holding plate to remove. The paper turn guide is made of rubber, care must be taken to avoid damage when removing.

⑤ Remove the paper guide spring from the hook of the paper turn guide and the facedown select knob.



⑥ Remove five screws of the cover holding plate and remove the cover holding plate assy from the facedown cover.

⑦ Remove the facedown select knob from the cover holding plate and remove the facedown select pin and the Facedown select spring. The inner surface of the facedown select knob must be lubed with white grease, when replacing.



b. Facedown chassis assy

① Remove the external panels (FD auxiliary panel, top panel, rear panel, operation panel) (B-①).

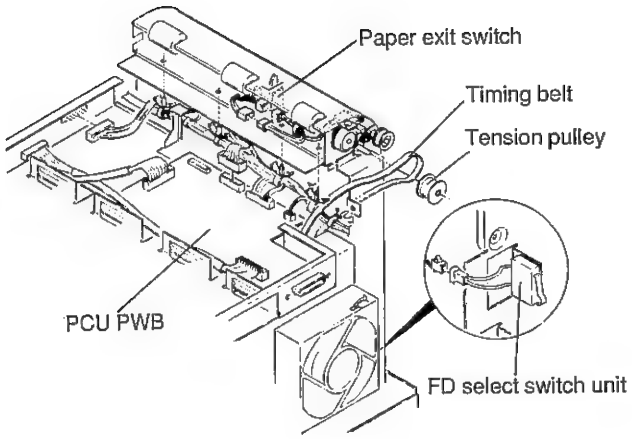
② Remove thirteen screws that hold the shield cover and remove the shield cover ((8)-2).

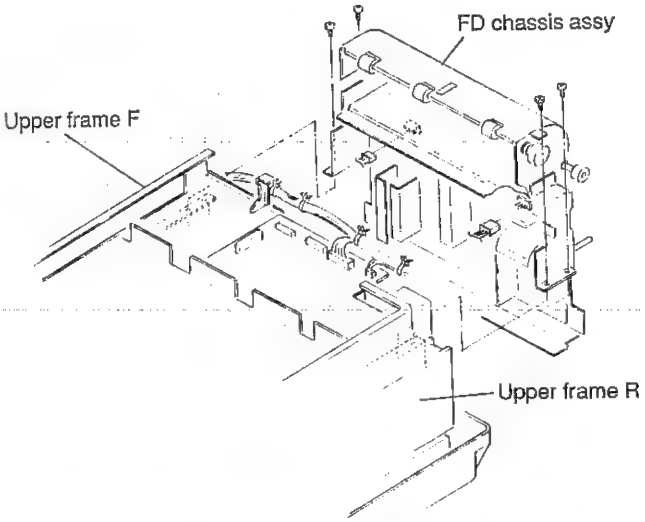
③ Unfasten connectors on the PCU PWB and remove the snap bands.

④ Unfasten the FD select switch connector and the paper exit switch connector (rear side).

⑤ Loosen the tension plate screw (M3) and remove the timing belt and the idle pulley.

⑥ Remove four screws of the upper frame F and R, and remove the facedown chassis assy.



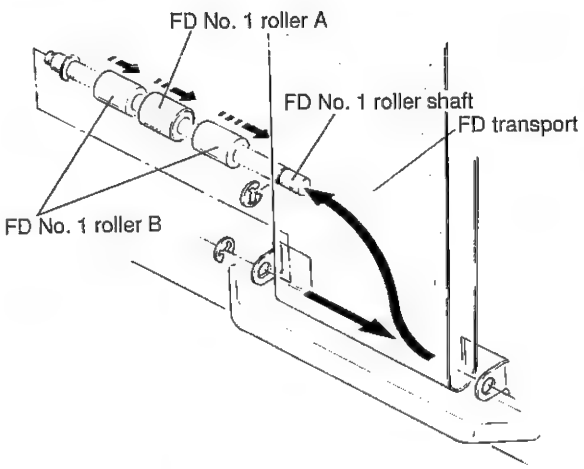


c. FD No.1 roller A, B transport belt

① Remove the No.1 roller holding E-ring (E4) from the No.1 roller shaft (front side).

② While pulling the transport belt, move the No.1 roller towards front side and remove it from the FD chassis.

③ Remove two No.1 rollers (A, B) from the No.1 roller shaft. The inner side of each roller must be lubed with white grease, when replacing.



④ Remove the No.2 roller holding grip pin G6 on the connection plate front side.

⑤ Loosen two setscrews (M3) that hold the pulley 21M x L on the connection plate rear side and remove the pulley 21M x L.

⑥ Remove the E-ring (E5) inserted on the No.2 roller shaft and bushing inserted on the front and rear sides of the connection plate

⑦ Move the No.2 roller towards the rear side and remove the No.2 roller and transport belt from the connection plate.

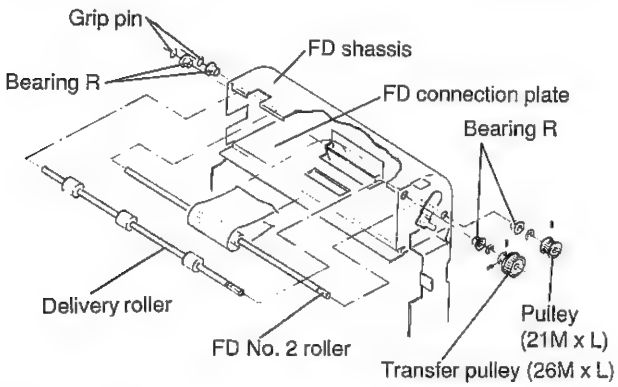
d. Paper delivery roller

① Remove the grip ring G6 on the front side of the connection plate.

② Loosen two setscrews (M4) that hold the pulley 26MxL on the connection plate rear side and remove the pulley.

③ Remove the E-ring inserted on the shaft of the paper delivery roller and bushing inserted on the front and rear sides of the connection plate.

④ Move the paper delivery roller towards the rear side and remove the connection plate.

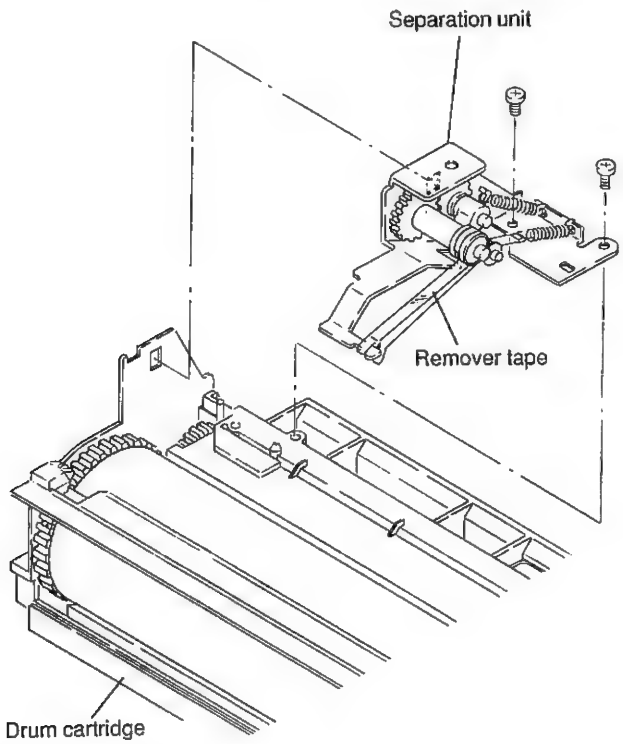


E. Remover tape

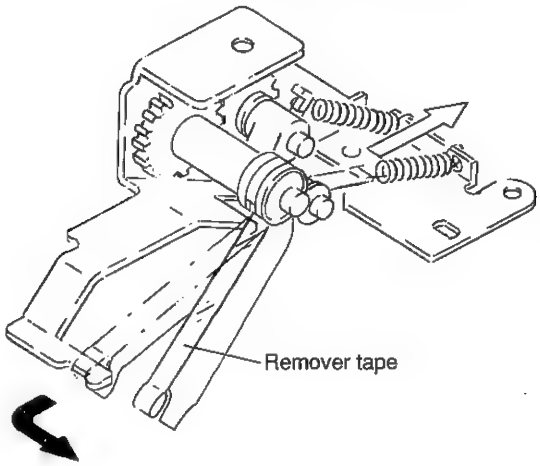
① Open the frames, then remove the developer cartridge and the drum cartridge.

② Remove the separation unit from the drum cartridge.

CAUTION: Do not expose the drum cartridge to direct sunlight.



③ Remove the remover tape from the separation unit.



[8] OPTICAL SYSTEM

1. General description

A laser beam issued from the semiconductor laser diode in synchronization with the video signal is focused collateral by means of the collimator. It is exposed to the polygonal mirror that keeps rotating at a given speed, and the laser beam scans in the main scan direction as the mirror rotates. The main scan laser beam enters the focus correction lens where it is collected and focused to the reflect mirror to reflect the beam on the drum. The point where write starts is the point where the laser beam coming out of the focus correction lens is reflected by the trigger mirror exposes the photodiode.

A. See the table below for the major components in the optical system.

Light source	Semiconductor laser diode (780nm wavelength) Laser output control PWB (APC circuit)
Deflector	Polygonal mirror, scan motor, control circuit board
Optics collimator	Focus correction lens, Reflect mirror, Collimator lens
Beam point detector	Pin diode Detect circuit board, Trigger mirror
Panels	Diecast housing and sealing cover

B. Optical system block diagram

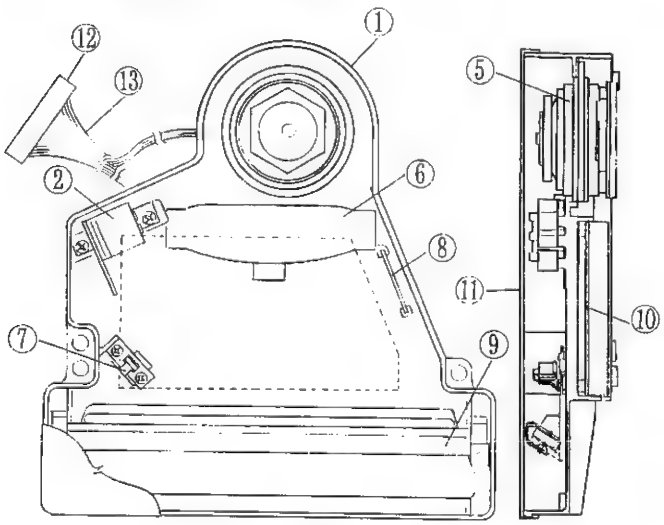


Fig.8-1-B

NOTE: Dont remove the optical system cover.

1. Diecast housing
2. Semiconductor laser diode and collimator lens
5. Polygonal mirror and scan motor
6. Focus correction lens
7. Trigger mirror
8. PIN diode and detect circuit board
9. Reflect mirror
10. APC circuit board
11. Sealing cover
12. Connectors
13. Leads

2. Removing the optical system

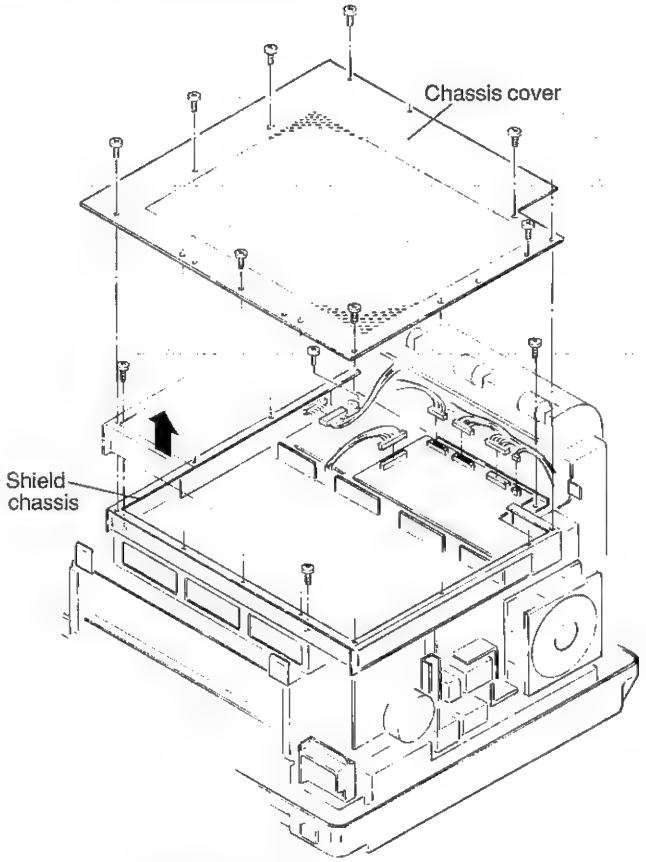
① Open the facedown cover and remove the FD auxiliary plate, top panel, and rear panel.

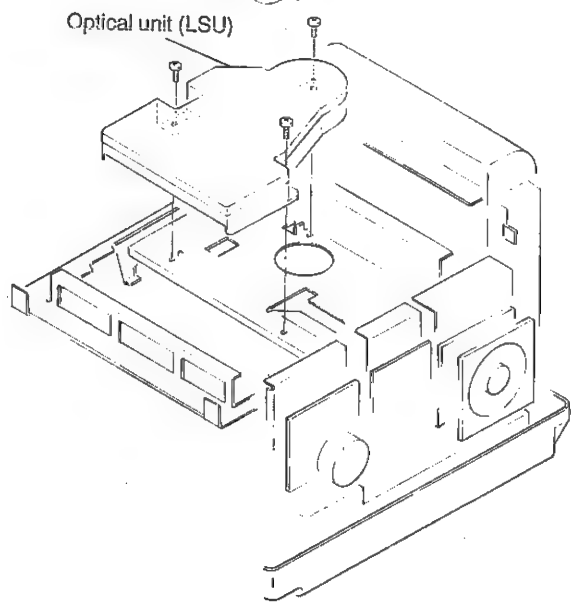
② Remove eight screws that hold the shield cover and remove the shield cover.

③ Unfasten five connectors on the PCU PWB and one connector on mother PWB.

④ Remove four screws that hold the shield case and one screw (M3) that holds the rear side fan motor bracket, then remove the shield case.

⑤ Remove three screws (M4) that hold the optical system and remove the optical unit.



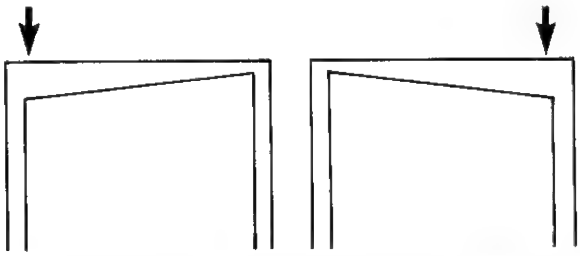


When a problem in the laser optical unit has occured, the whole optical unit must be exchanged as a unit, not a individual part.

3. Adjustments

A. Lead edge skew adjustment

If lead edge skew is out of limits (o to 1.5mm), it has to be adjusted in the following manner:



① If printed right side up, increase the clearance between the optical baseplate positioning guide and the optical system case protrusion by 0.5mm. (basic clearance is 1mm)
If printed opposite, decrease the clearance by 0.5mm.

② Secure the shield case with five screws (M3), fasten five connectors to the PCU PWB, and secure the shield cover with eight screws (M3).

③ Replace in order of the rear panel, top panel, FD auxiliary panel.

④ With the SELECT and LINE key depressed at the same time, turn power on to go into the service engineer diag mode.

⑤ Depress the up-arrow key twice to pick up the diag mode 12, then push the PRINT switch.

⑥ Measure the lead edge print area using the lateral stripe printing to make sure it is within the limits.
If not within the limits, repeat from step ① again.

B. Lead edge adjustment

If the lead edge of the printout is not within the limits (3.1 to 6.1mm), observe the following procedure to adjust it.

① Turn power on while depressing the SELECT key with the LINE key at the same time. With this, it goes into the diag mode 10.

② Push the PRINT switch and the lead edge adjust value is displayed.

③ If it was below the limit, push the up-arrow key. The value increments 1/100 inch (0.25mm) each time the key is depressed. Use the down-arrow key, if it was above the limit.

④ Push the CLEAR key to set the value.

⑤ Push the PRINT switch to obtain the lateral stripe printout and measure the lead edge area. If it is not within the limits yet, push the PRINT switch and repeat from Step ② again.
If it was within the limit, turn power off.

C. Left margin adjustment

If the left margin is not within the limits (4.4 to 8.4mm), observe the following procedure to adjust it.

① Turn power on while depressing the SELECT key with the LINE key at the same time. With this, it goes into the diag mode 10.

② Push the up-arrow key once to go into the diag 11.

③ Push the PRINT switch to bring the left margin adjust value in the display.

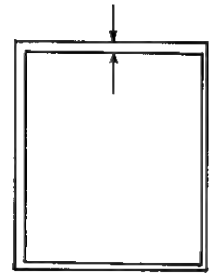
④ If it was below the limit, push the up-arrow key. The value increments 1/100 inch (0.25mm) each time the key is depressed. Use the down-arrow key, if it was above the limit.

⑤ Push the CLEAR key to set the value.

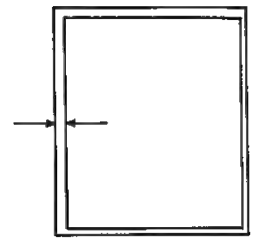
⑥ Push the PRINT switch to obtain the lateral stripe printout and measure the margin area. If it was not within the limits yet, push the PRINT switch and repeat from Step ③ again.
If it was within the limit, turn power off.

8-2. Print accuracy

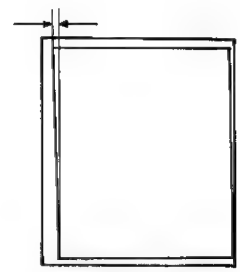
A. Top margin
5.1mm -2mm to +1mm



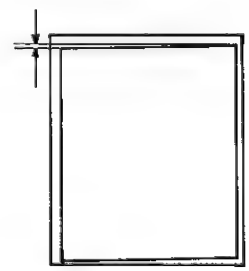
B. Left margin
6.4mm -2mm to +2mm



C. Skew
8-1/2" x 11" landscape,
2mm, maximum



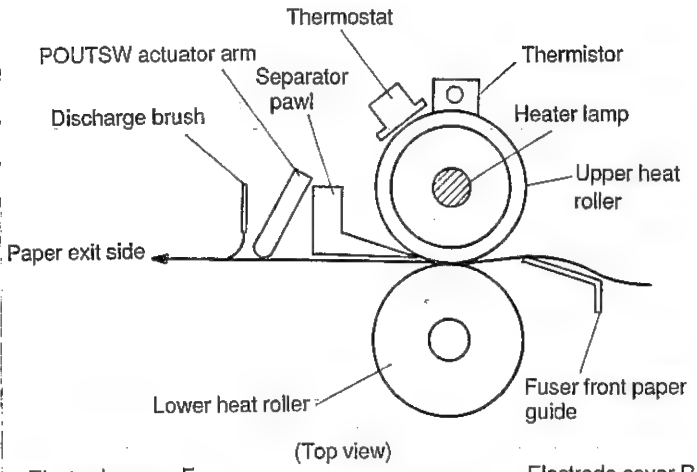
D. Lead edge skew
1.5mm, maximum



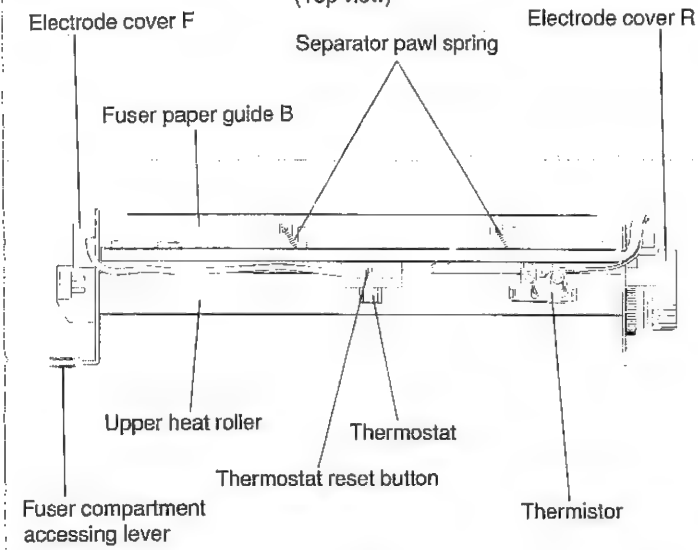
[9] FUSER UNIT

1. General description

Cross sectional view



(Top view)



A. Heat roller

A teflon roller is used for the upper heat roller and a silicon rubber roller is used for the lower heat roller for better toner fusing performance and paper separation.

Simple raising of the fuser compartment accessing lever separates the upper heat roller from the lower heat roller to enhance easier misfed paper removal.

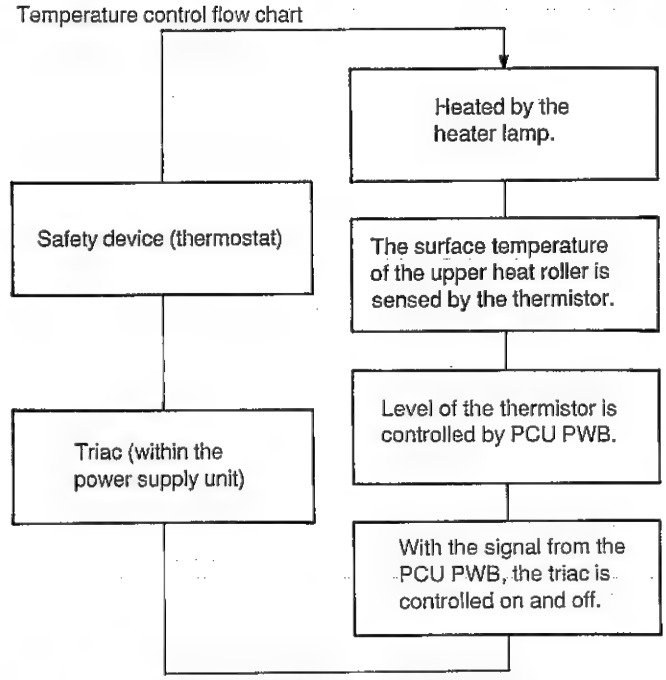
B. Separator pawl

Two separator pawls are used on the upper heat roller. The separator pawl is teflon coated to reduce friction with the roller.

C. Thermal control

① The heater lamp, thermistor, main PWB, DC power supply PWB, and triac within the power supply unit are used to control the temperature in the fuser unit.
To prevent irregularly high temperature in the fuser unit, a thermostat is used for safety purposes.

Temperature control flow chart



② The surface temperature of the upper heat roller is set to 165°C. The surface temperature during the power save mode is set to 100°C.

③ The self-check function comes active when one of the following malfunctions is met, and an error is prompted in the display.

a. When the heat roller surface temperature rose above 230 to 250°C, the status "C4" is displayed.

b. When the heat roller surface temperature dropped below 90 to 100°C during the print cycle, the status C5 is displayed.

c. When the thermistor opened, the status "C6" is displayed.

d. When the thermostat contacts are open due to irregularly high heat roller temperature, the status "C4" is displayed (*1).

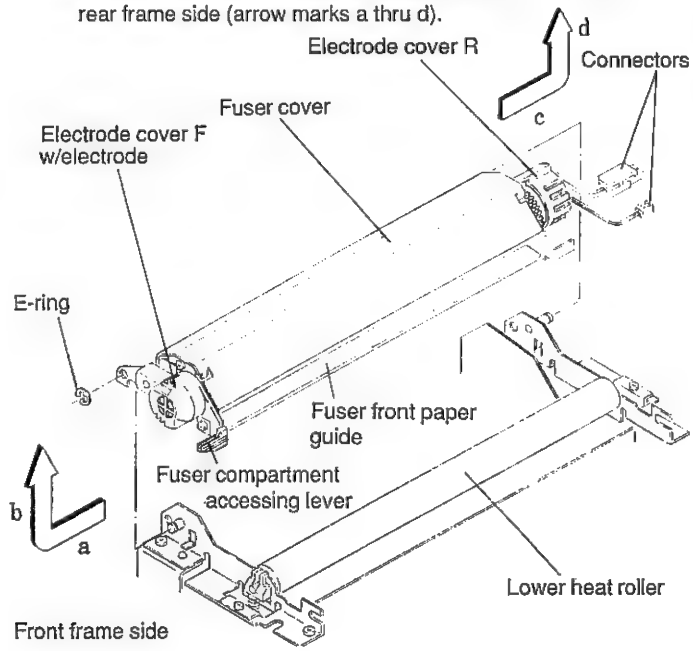
*1: When the thermostat contacts are open, the reset button on the thermostat must be pushed to reset it, as the contacts do not restore automatically.

2. Major component removal

A. Upper heat roller

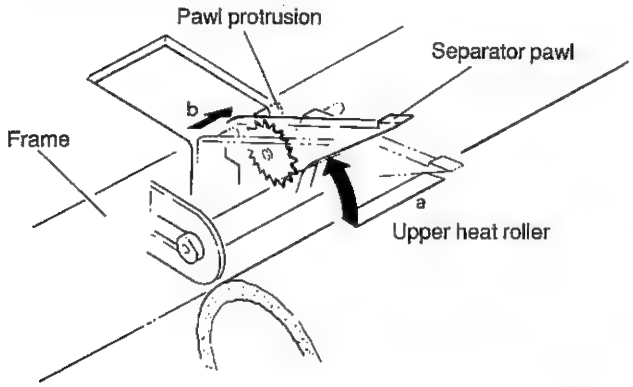
① Open the frames.

② Remove the E-ring and unfasten the two connectors and fuser ground strap, then remove the upper fuser unit. To remove it, remove the boss on the front frame first, then the one on the rear frame side (arrow marks a thru d).

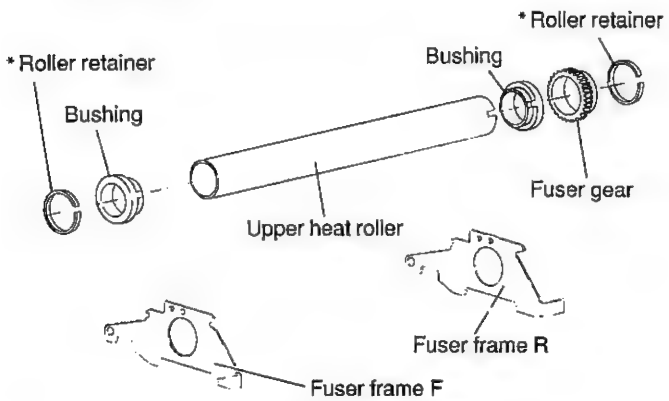


③ Remove the fuser cover, electrode covers F and R, and the heater lamp.

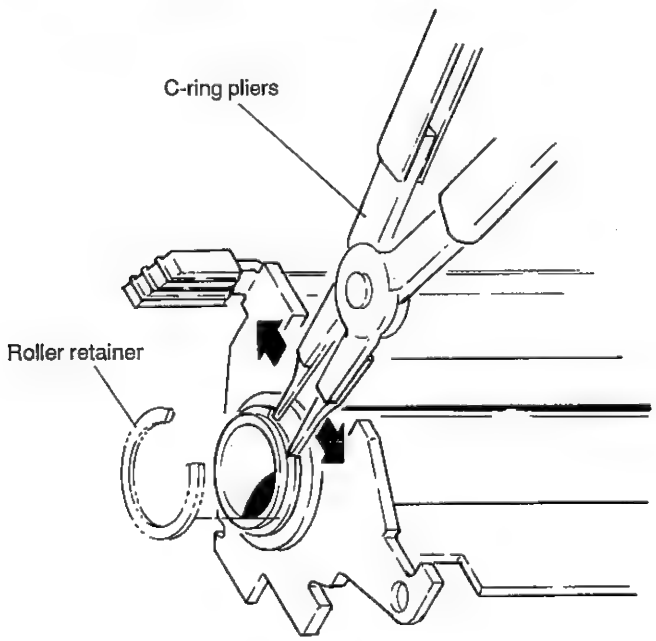
④ To separate the separator pawl from the upper heat roller, hook the protrusion of the separator pawl on the frame in order of arrow heads a and b.



⑤ Remove the roller retainer, gear, bushing, then remove the upper heat roller.

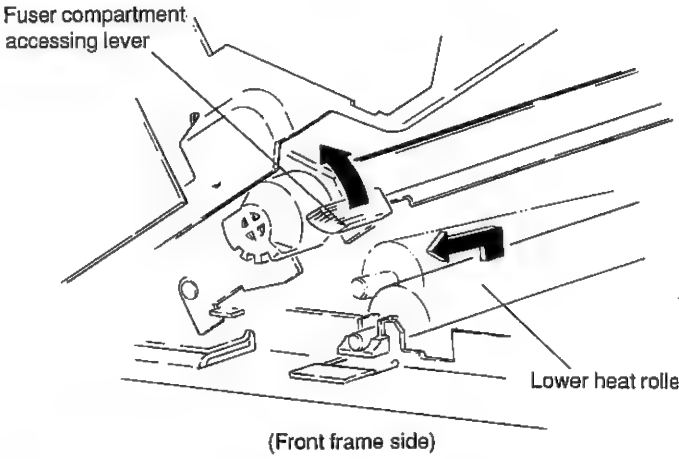


* Use the C-ring pliers to remove the roller retainer.



B. Lower heat roller

① Open the frames and lift up the fuser compartment accessing lever.
Then, lift the lower heater up to remove it from the bushing.

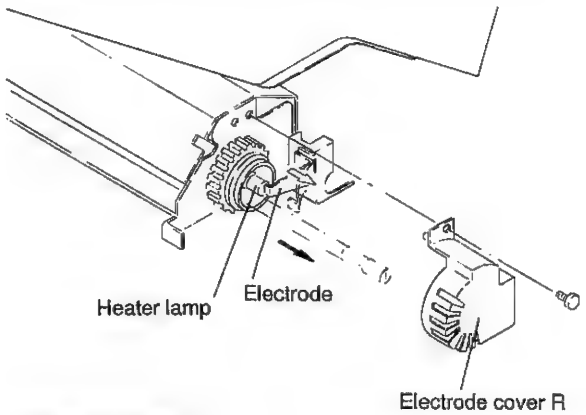


(Front frame side)

C. Heater lamp

① Open the frames and remove the electrode cover R.

② Remove the heater lamp from the electrode, then take it out.



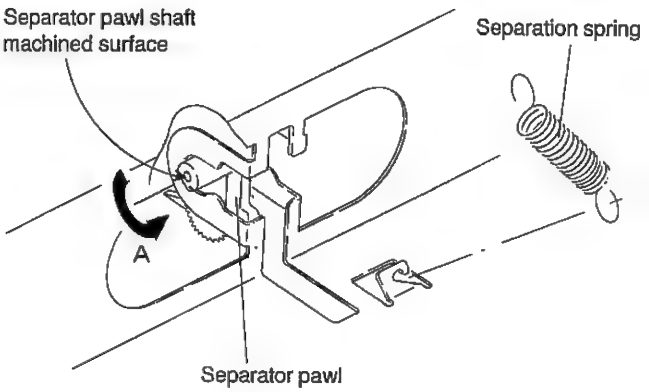
(Rear frame side)

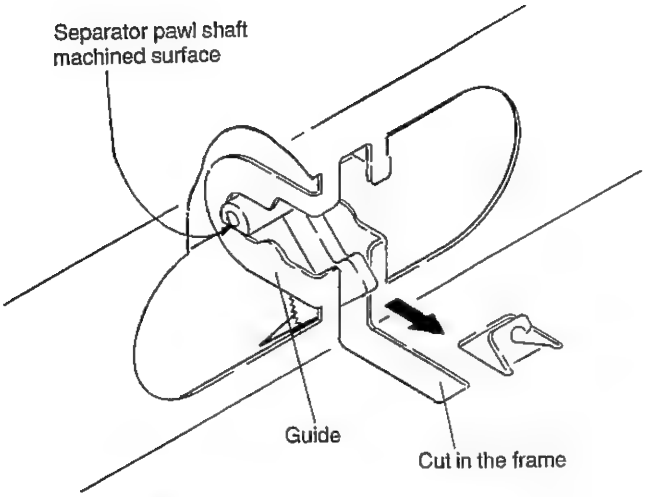
D. Separator pawl

① Remove the upper fuser unit

② Remove the fuser cover.

③ Remove the tension spring. Rotate the pawl in direction a and match the machined surface of the separator pawl shaft to the guide, then remove it from the notch.



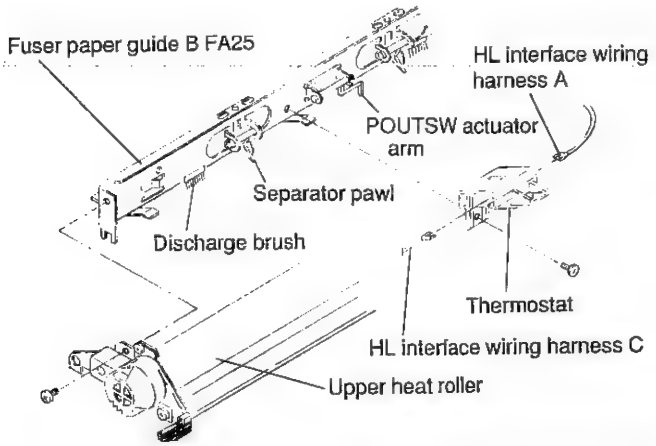


E. Thermostat, thermistor (thermal fuse) unit

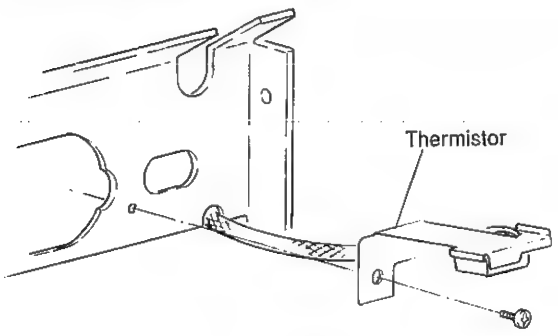
① Remove the upper fuser unit, then remove the fuser cover.

② Remove the fuser paper guide B.

③ Remove the screws, HL interface wiring harness, and nut, then remove the thermostat and the thermistor unit.



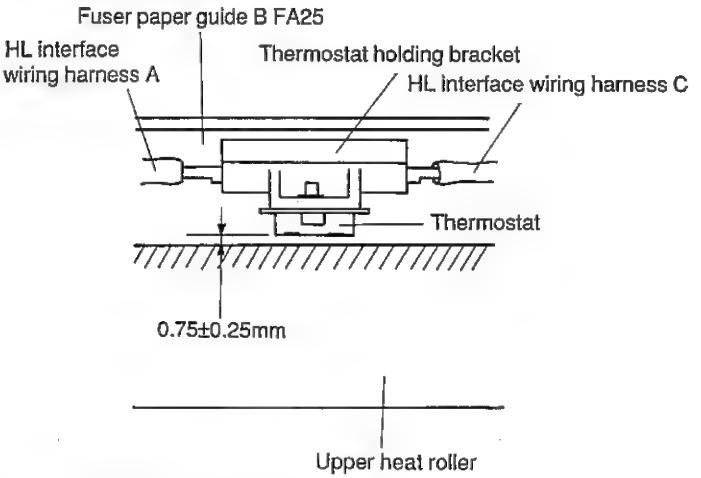
④ Remove the M3 screw that fastened to the fuser paper guide B FA25 and remove the thermistor.



NOTE: Check items after the installation

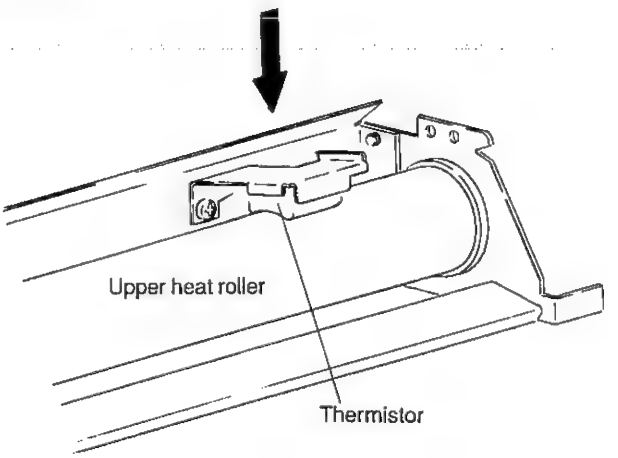
■ Thermostat

Check to see that the gap between the thermostat and the heat roller is 0.75±0.25mm.



■ Thermistor

Make sure that the center of the thermistor is in contact with the heat roller.



[10] OTHERS

1. Main motor unit, main motor gear, fan motor, HC-TC sockets, high voltage units

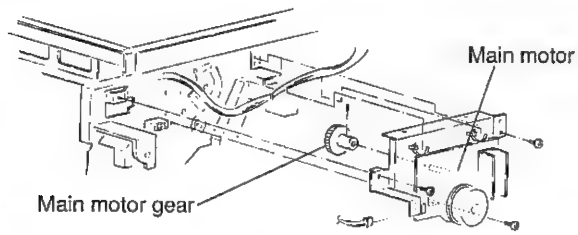
① Open the facedown cover and remove the external panels (FD auxiliary panel, top panel, rear panel).

② Open the upper frame and unfasten the DV switch and PSS lead switch connector and remove the wiring ties.

③ Remove three screws (M3) that hold the unit and remove the main motor unit.

* Pay attention not to damage the main motor gear as it is precision built.

④ Remove two main wiring harness snap bands on the main motor bracket.



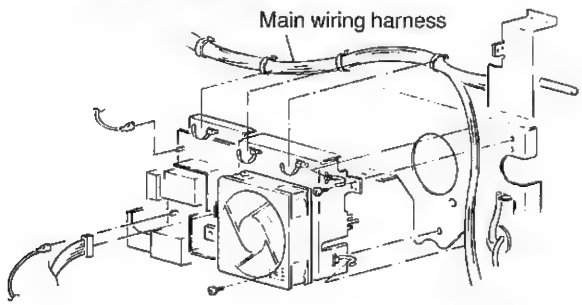
⑤ Remove one setscrew (M4) that secures the motor gear and remove the motor gear.

⑥ Unfasten the bias and main corona connectors from the high voltage PWB.

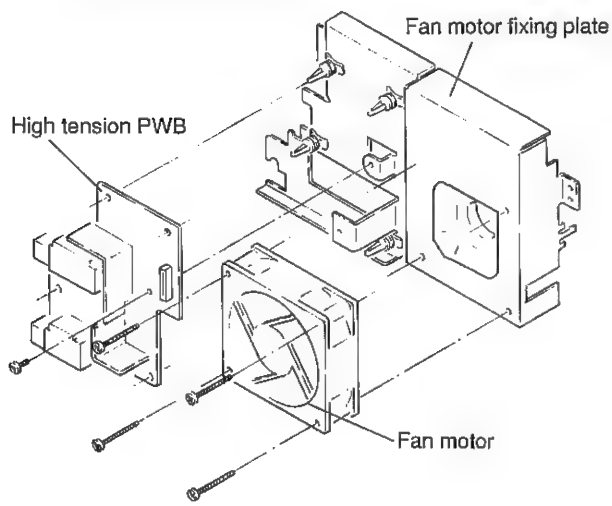
⑦ Unfasten the fan motor connector from the CPU PWB.

⑧ Remove five snap bands that hold the main wiring harness.

⑨ Remove two screws (M3) that secure the fan motor bracket, then remove the fan motor.

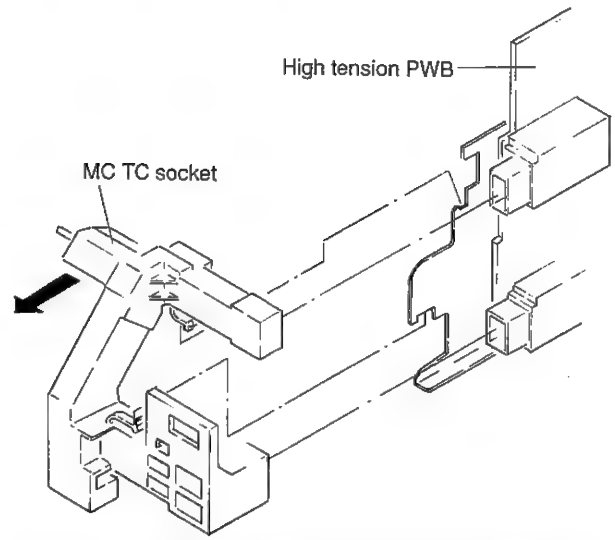


⑩ Remove four screws (M4 x 30) that secure the fan motor, then remove the fan motor.



⑪ Push the tab of the MC-TC socket assy up and down to remove the assy in the arrow direction.

* Clearance between the MC-TC socket and the socket of the PWB unit must be more than 1mm, when replaced.



⑫ Remove one screw (M3) that holds the high voltage unit.

⑬ Remove four board support columns and remove the high voltage PWB unit.

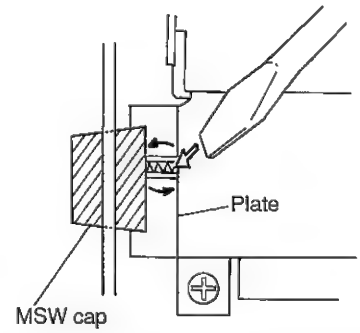
2. DC supply unit

① Remove the face down stacker

② Remove six screws (M3). Remove the DC supply unit and the insulation plate FD.AC Supply Unit

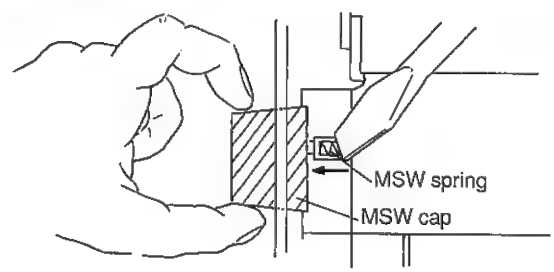
3. AC Supply unit

1. Turn off the MSW.
2. Insert a screwdriver (–) between the MSW cap and the plate as shown in the figure below, and turn the screwdriver counterclockwise (in the direction of arrows) until it clicks.

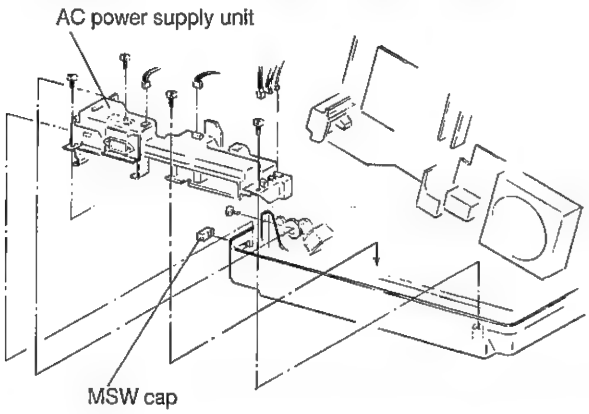


3. Pinch the MSW with your fingers as shown below and push it with a screwdriver in the direction of arrow, and remove the cap.

In procedures 2 and 3, the screwdriver must be placed at the spring of the MSW.



4. Remove the five screws as shown below, and pull out the five connectors. Then the AC power unit can be removed.

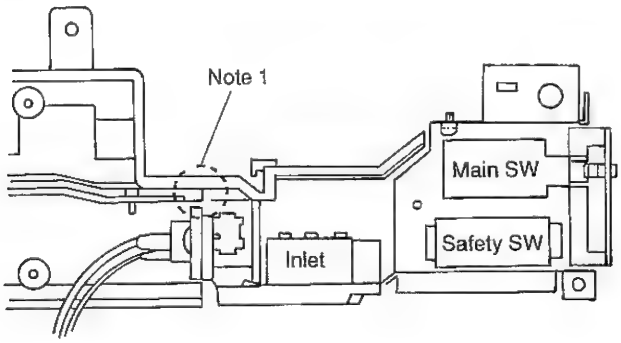


When reassembling the AC power unit after repair, observe the following precautions:

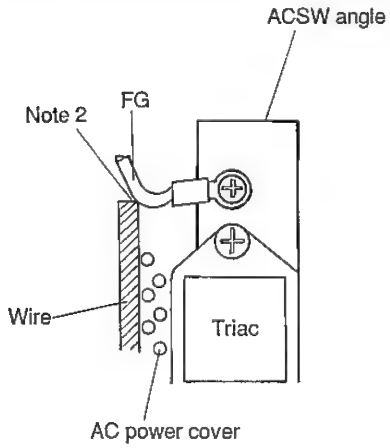
- Precaution on assembling the harness to ( ) section (Note 1)

  100V system: Adjust so that the center of the UL tube is around the heat-radiator fin. (Check that all the wires except for PFS wire are passed through their UL tube.)

  200V system: After assembling PFS wire, be sure to assemble the two double-insulated wires (the thickest wires) from the safety switch before assembling the other wires.



- After the above procedure, fix the grounding wire (FG) from the AC PWB with the brass screw as shown below to prevent the wires from extruding from the point (Note 2).



4. Reassmbling procedure of AC power unit

(Descriptions in the figure below)

① Lift the fuser unit together with the harness section.

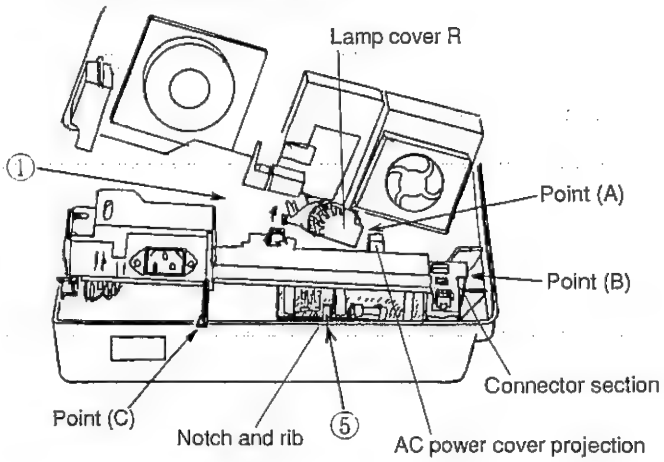
② Place the AC power unit in parellel with the bottom cabinet as far as possible.

③ (Point (A)) Adjust so that the AC power cover projection comes beside the lamp cover R.

④ (Point (B)) First insert the connector section (PWB side) of the AC power into the bottom cabinet.

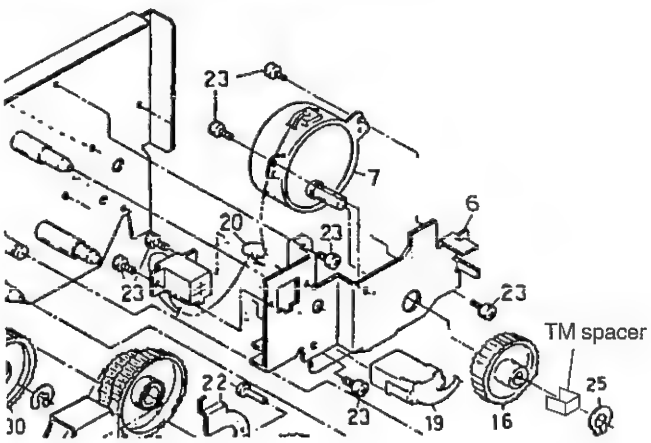
(Point (C)) Keep the ACSW side lifted, maintaining the parallelism with the bottom cabinet.

⑤ Fit the notch section of the AC power PWB and the rib of the bottom cabinet, and assemble the AC power unit.



5. TM gear 29 replacement

Remove the grip ring (No. 25) and the TM spacer in the figure below, and replace the TM gear 29 (No. 16).



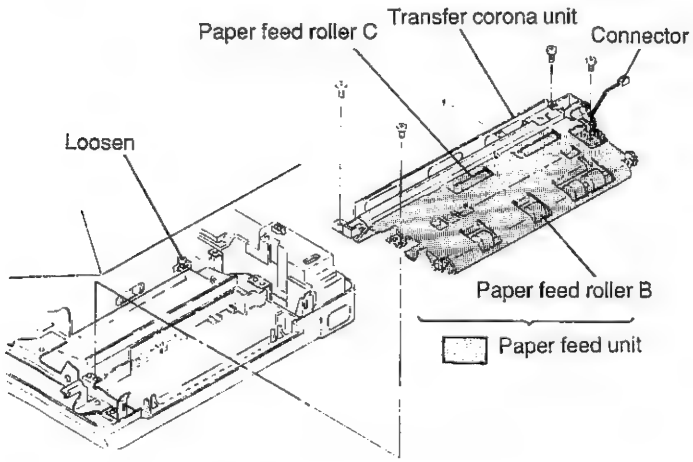
6. Overhaul procedure at every 100K copies

Overhaul parts list

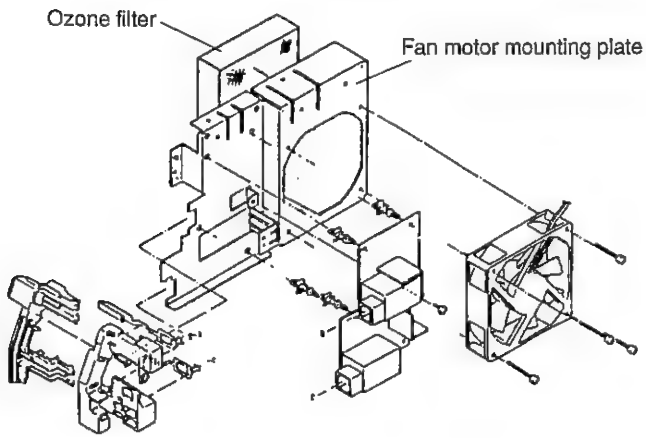
NO.	PARTS CODE	DESCRIPTION	Q'TY
1	PFILZ0128FCZZ	Ozon filter	1
2	DUNTW6133FCZZ	Fusing Unit (120V U.S.A.)	1
	DUNTW6133FC11	Fusing Unit (220V)	1
	DUNTW6133FC12	Fusing Unit (240V)	1
	DUNTW6133FC13	Fusing unit (120V CANADA)	1
3	CGIDH0822FC35	Paper feeding Unit	1
4	QSW-L0306FCZZ	PISW/HFSW	1

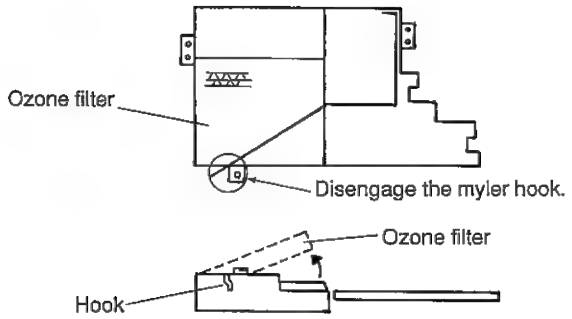
Replacement procedure

1. Remove the external cabinets (FD additional plate, upper cabinet, rear cabinet, right cabinet, front cabinet).
2. Replace the paper feed unit.
   ① Open the main body. Remove the paper feed solenoid connector. Remove the paper feed unit fixing screws and remove the paper feed unit. (Remove the four screws and loosen the one with mark*.)

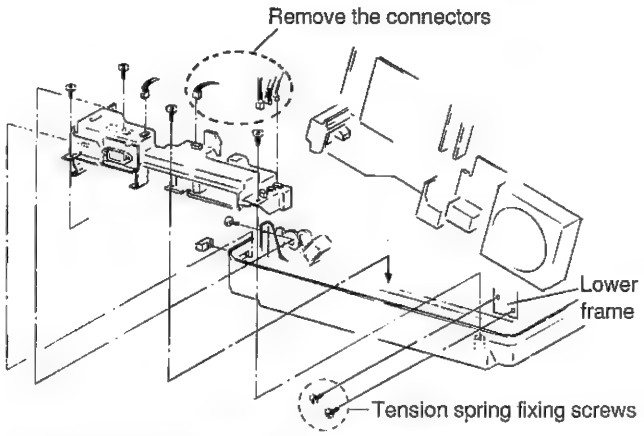


3. Ozone filter replacement
   ① Remove the main motor fixing screws (3 pcs.)
   ② Remove the fan motor mounting plate fixing screws (3 pcs.)
   ③ Remove the myler hook as shown below, and remove the ozone filter in the direction of arrow.





4. Fuser unit replacement
   ① Fig 1

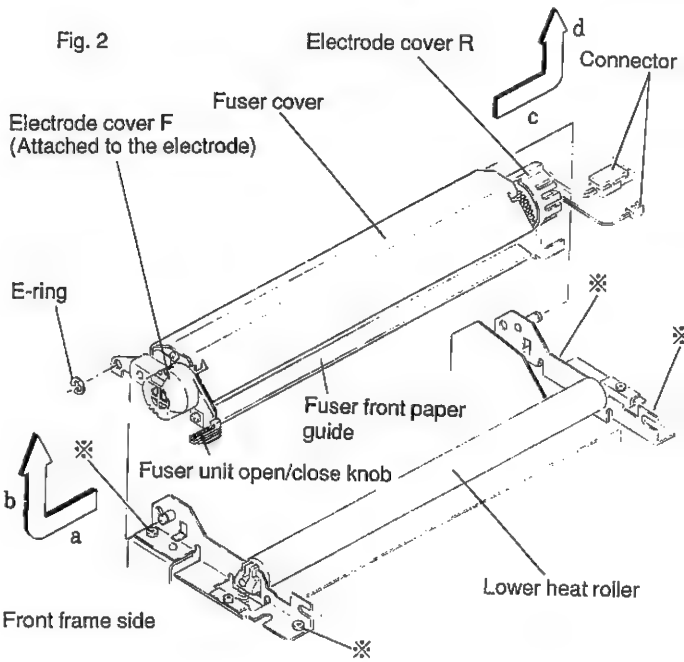


Remove the connectors shown in the figure above. Remove the torsion spring fixing screws which are on the lower frame. (Total 4 pcs. front and rear sides.)

② Separate the upper frame unit from the lower frame unit.

③ Remove the screws (4 pcs.) which are marked with * in the figure below and remove the fuser unit.

Fig. 2



5. Clean the inside of the machine with a vacuum cleaner.
6. Reverse the above procedure for reassemling.

[11] TEST PRINT FUNCTION AND DIAGNOSTIC PROGRAM

A. Test print function

The following test modes are available by setting to the off-line state after the READY lamp lights up. Then by setting the select key to the desired test print mode. To select the mode, use Δ, ∇ keys. Press the print key to start printing.

d1: Diagonal print, max. print area, ROM version print.

d2: Function setting contents printed.

CONTENTS OF FUNCTION SETTING

F1. MULTI-PRINT

F2. PAPER SIZE

F3. PRINTED PAGE ORIENTATION

F4. BACKUP

F5. HEX DUMP

F6. INTERFACE AND PROTOCOL

F7. EMULATION AND PRINT FUNCTIONS

For details, please refer to the operation manual.

d3: Printable font contents printed, registered macro list printed

B. Diagnostic program

There are two kinds of diagnostic programs: (1) User diagnostics, and (2) service engineer's diagnostics.

The procedures to actuate the diagnostics are as follows:

(1) User diagnostics

1. While holding down the SELECT key, press the power switch to turn on the power.
2. Select diag No. by up or down key.
3. Press the PRINT key to start.
4. Press the CLEAR key to termination.

(2) Service engineer's disgnostics

1. While holding down the SELECT key and LINE key, press the power switch to turn on the power.
2. Select diag No. by up or down key.
3. Press the PRINT key to start.
4. Press the CLEAR key to termination.

To exit from the diagnostic mode, execute diag No. 59 or turn off the power.

The PCU diagnostic list is given below:

(1) User diagnostic

No.	Start	Functional description	Stop & Set
01	[PR]	Display remaining life of the photoconductor (The POWER, READY and ERROR lamps will light in sequence. With the lighting of each lamp, the STATUS display will show 2 digits.)	[CL]
02	[PR]	Display remaining life of the developer (Will be displayed in the same manner as (01) above.)	[CL]
03	[PR]	Display the value in the overhaul counter (Will be displayed in the same manner as (01) above.)	[CL]
04	[PR]	Installing the photoconductor cartridge.	
05	[PR]	Installing the developper cartridge.	
06	[PR]	Sleep mode setting SP → Sleep mode nL → Normal mode	[CL]

(2) Service engineer's diagnostics

No.	Start	Functional description	Stop & Set
10	[PR]	Display the lead edge adjusted value, 00 - 99 (1/100 inch per count) Use the Δ key to count up, and the ∇ key to count down. Push the PRINT switch to make a copy of landscape stripes. (Same as 12.)	[CL]
11	[PR]	Display the left margine adjusted value, 00 - 99 (1/100 per count) Use the Δ key to count up, and the ∇ key to count down. Push the PRINT key to make a copy of landscape stripes. (Same as 12.)	[CL]
12	[PR] [LI] + [PR]	Producing a single copy of landscape stripes. The first line is printed more boldy than the other lines. The first bolder line is used for checking the top margin. Multipage print (landscape stripes)	[CL]
13	[PR]	Sames as diag No. 33	[CL]
20	[PR]	Display on the 7-segment LED, the active state of internal switches Switch state, Lamp, 7-segment LED Door open, dO DVSW, Print lamp PISW, Test lamp HFSW, Set lamp POSW, Line lamp FDOWN, Error lamp FDOUTSW, Ready lamp	[CL]
21	[PR]	Display the depressed operation panel key on the 7-segment LED. Depressed key, Lamp, 7-segment display PRINT key, PRINT lamp, Pr CLEAR key, ERROR lamp, CL LINE key, LINE lamp, LI SELECT key, READY lamp, SE Δ key, TEST lamp, UP ∇ key, SET lamp, dn	Power off
22	[PR]	Testing the heater lamp 3 alternate cycle of 1-second ON and 3-seconds OFF	[CL]
23	[PR]	Testing the main corona (30 seconds) Push the Δ key to test a high output, and push the ∇ key to test a low output.	[CL]
24	[PR]	Testing the transfer corona (30 seconds)	[CL]
25	[PR]	Activating the discharge lamp (30 seconds)	[CL]
26	[PR]	Testing bias (20 seconds)	[CL]
28	[PR]	Testing PFS (0.5-sec ON and 1-sec OFF, multi)	[CL]
29	[PR]	Testing PSS (1-sec ON and 1-sec OFF, multi)	[CL]
30	[PR]	Testing the toner motor Toner motor ON	[CL]
31	[PR]	Testing the main motor Main motor: ON, Discharge lamp: lights up. Main corona: ON Bias: ON (When toner is exhausted, the Error lamp lights up.)	[CL]
32 *1	[PR]	Testing the laser optical system The polygon motor and the semiconductor laser: ON (20 sec)	[CL]
33	[PR]	Testing the optical system control The polygon motor and the semiconductor laser: ON When semiconductor laser beam is detected, the error lamp lights up. 300dpi optical system: 3d display	[CL]
34	[PR]	Aging test without paper Paper jamming is not detected. Use the Δ key to turn off the laser. Use the ∇ key to turn on the laser. (The error lamp lights up.) Only when CMISSW is ON.	[CL]
38	[PR]	Display heater ready time Flashes while the heater is being warmed up. Turns on when the heater is ready. The error lamp lights up when the heater lamp temperature is above 100 degrees C.	[CL]
50	[PR]	Displaying the total counter contents (two digits at a time)	[CL]
59	[PR]	Diag mode termination.	
60	[PR]	Initializing the non-volatile RAM Left margin adjustment: 50 Lead edge adjustment: 50 Counter: Overhaul: 100,000 Photoconductor: 30,000 Developer: 10,000	*2
61	[PR]	Setting the photoconductor counter (to be set by two digits from the upper at a time) Push the Δ key to count up, and the ∇ key to count down. Push the CLEAR key to go to next line.	[CL]
62	[PR]	Setting the developer life counter (Similar to 61.)	[CL]
63	[PR]	Setting the overhaul counter (Similar to 61.)	[CL]
64	[PR]	Initializing the counter Overhaul: 100000 Photoconductor life counter: 30,000 Developer life counter: 10000	*2

*1: Don't execute this diagnostic function, when the photoconductor cartridge is installed.

*2: Automatically terminate.

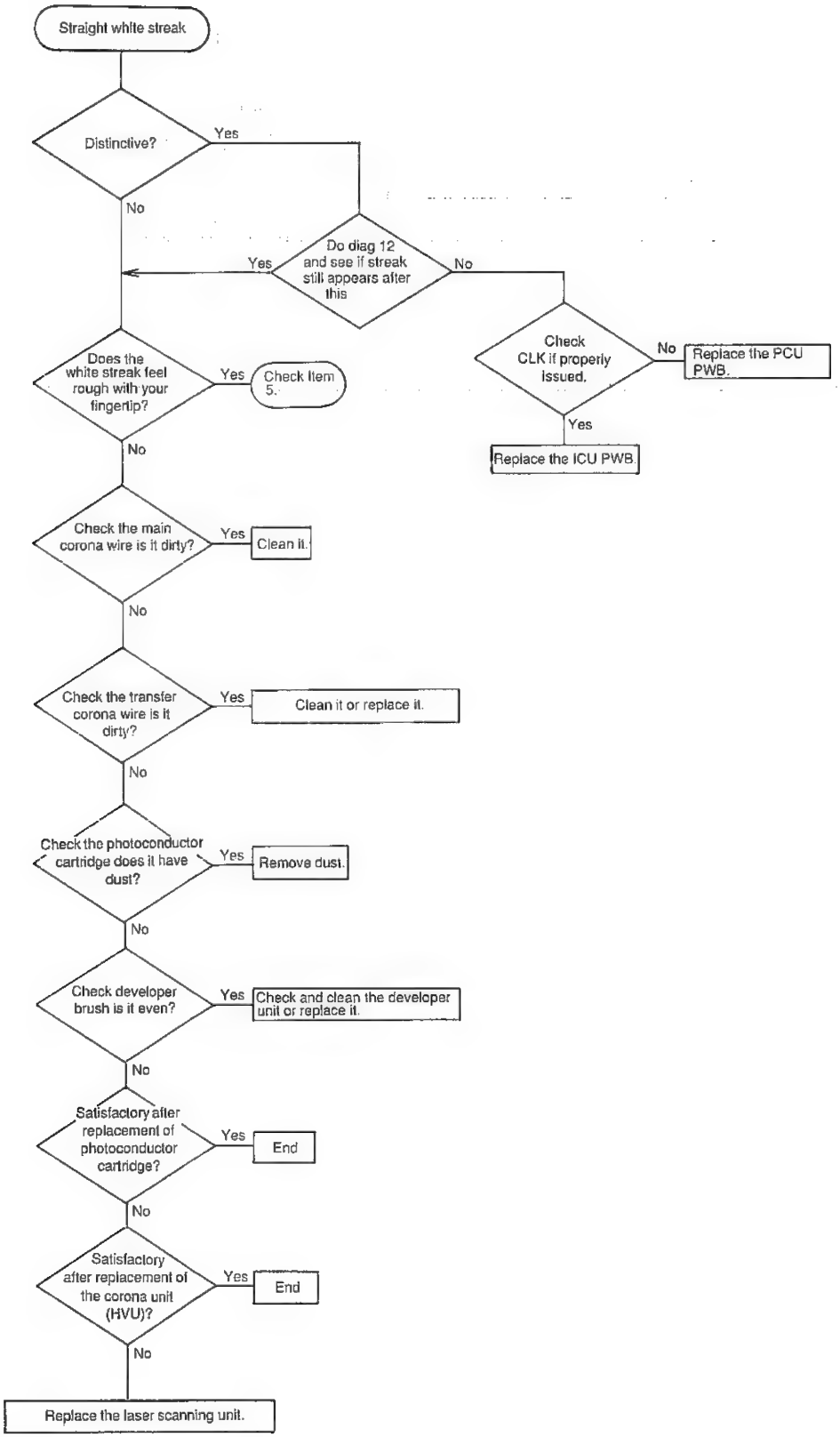
[12] TROUBLESHOOTING

Troubleshooting (A) is for printing troubles, and troubleshooting (B) is for error codes.

(A) Printer troubleshooting

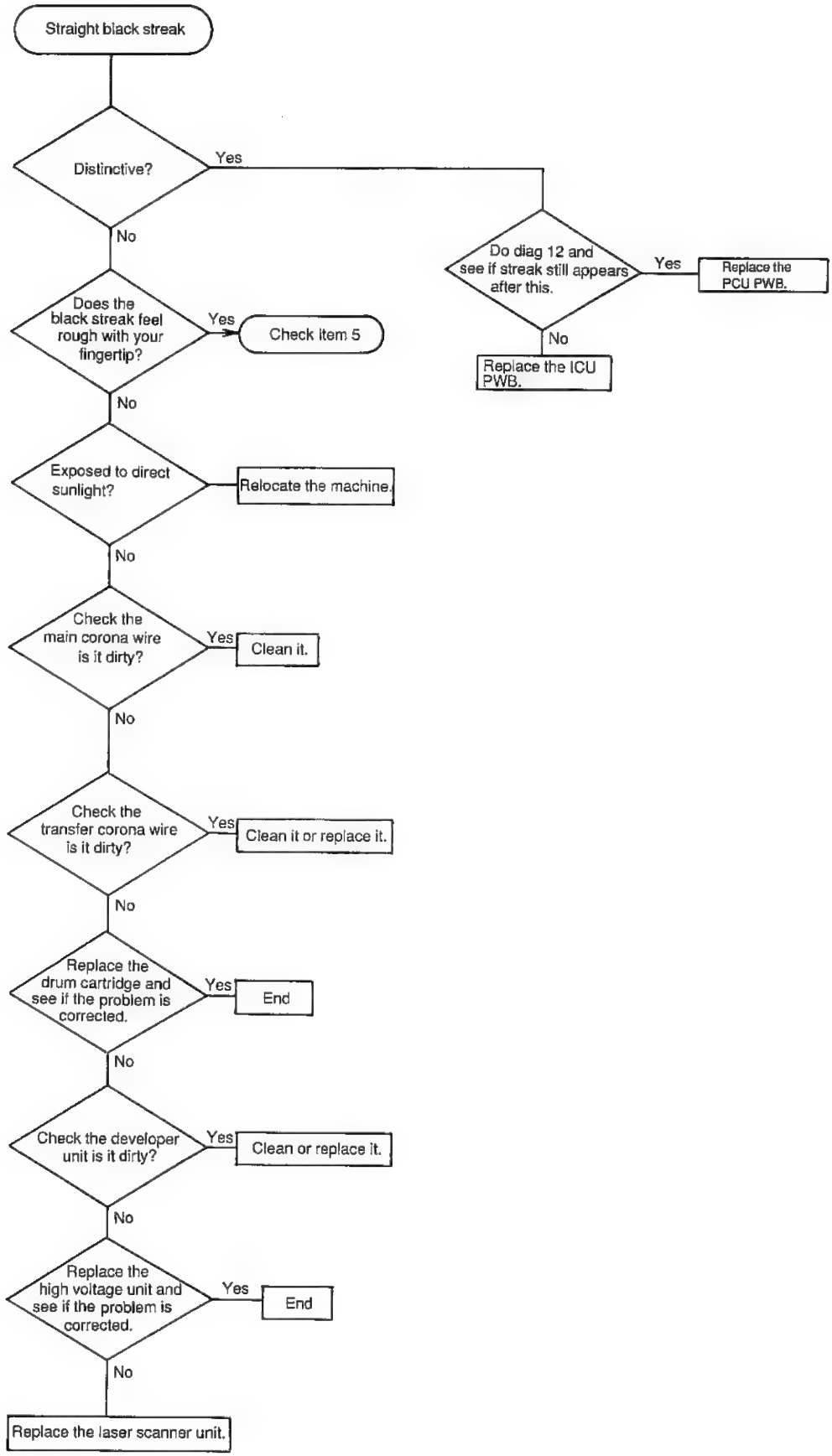
1. White line appearing vertically on print

■ Appearance of white streak or band in the paper feeding direction



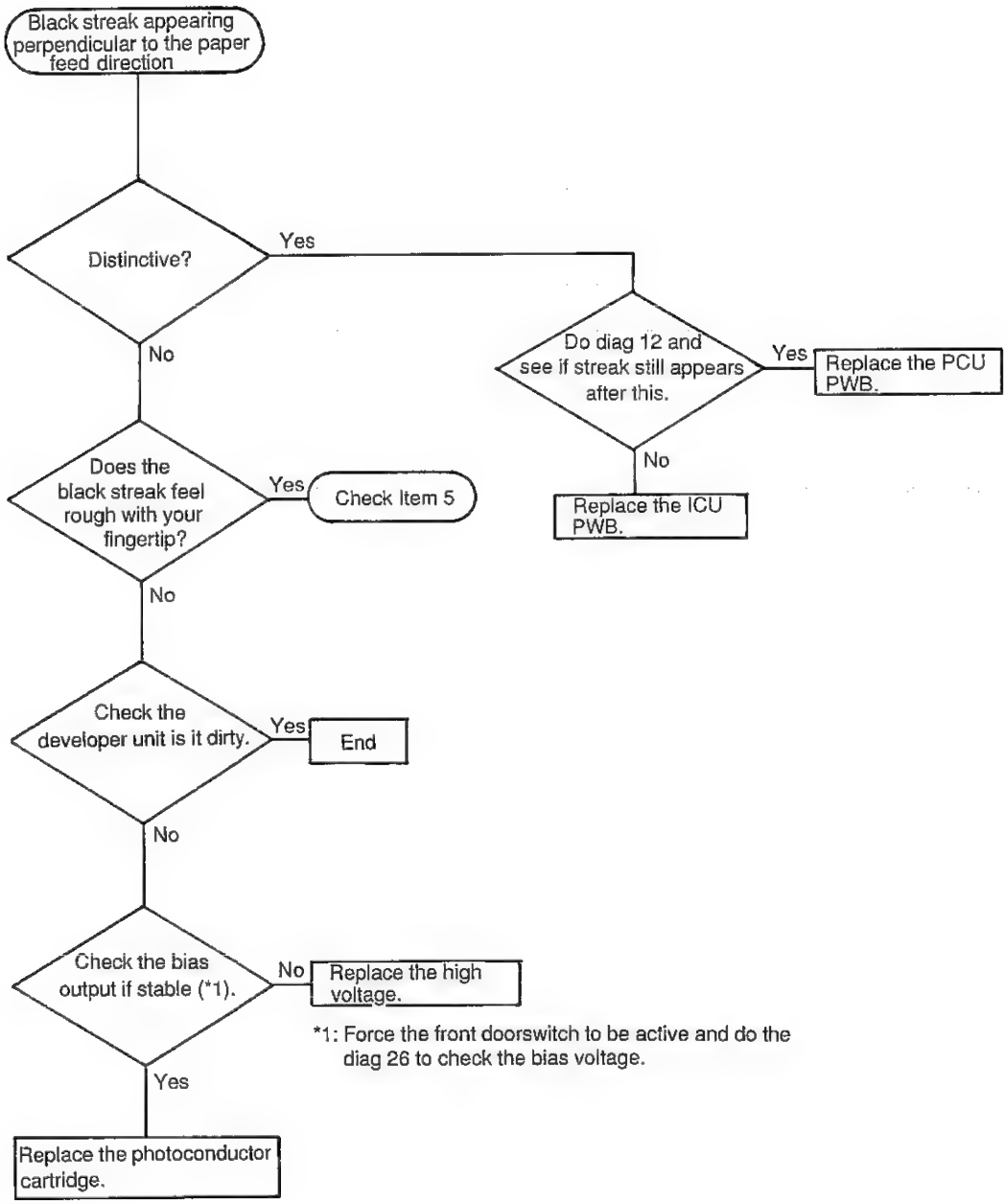
2. Black line appearing vertically on print

■ Appearance of black streak or band in the paper feeding direction



3. Black line appearing horizontally on print

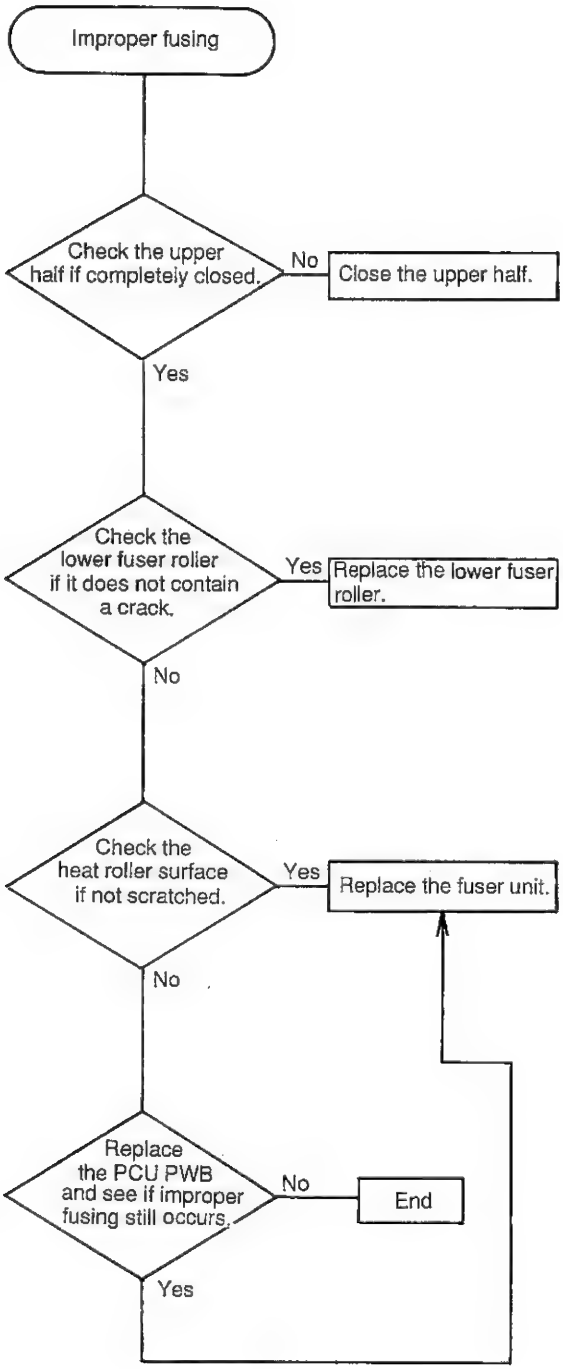
■ Appearance of black streak or band perpendicular to the paper feeding direction



*1: Force the front doorswitch to be active and do the diag 26 to check the bias voltage.

4. Poor fusing

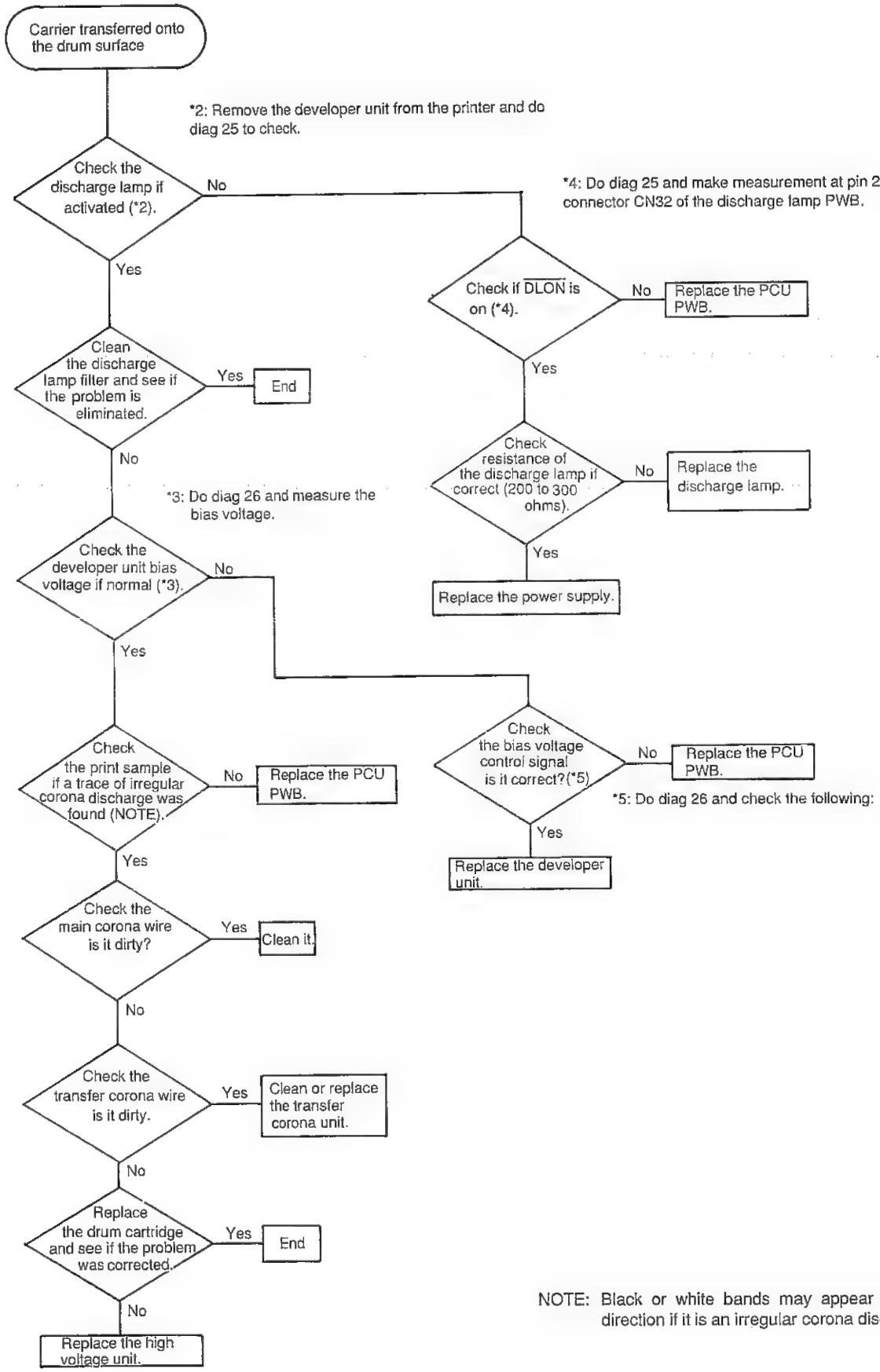
■ Printed image felt rough and toned image easily wiped away with your fingertip



NOTE: If the status C4 to C6 is in the display, follow the direction given for that particular status.

5. Carrier transferred onto the drum surface

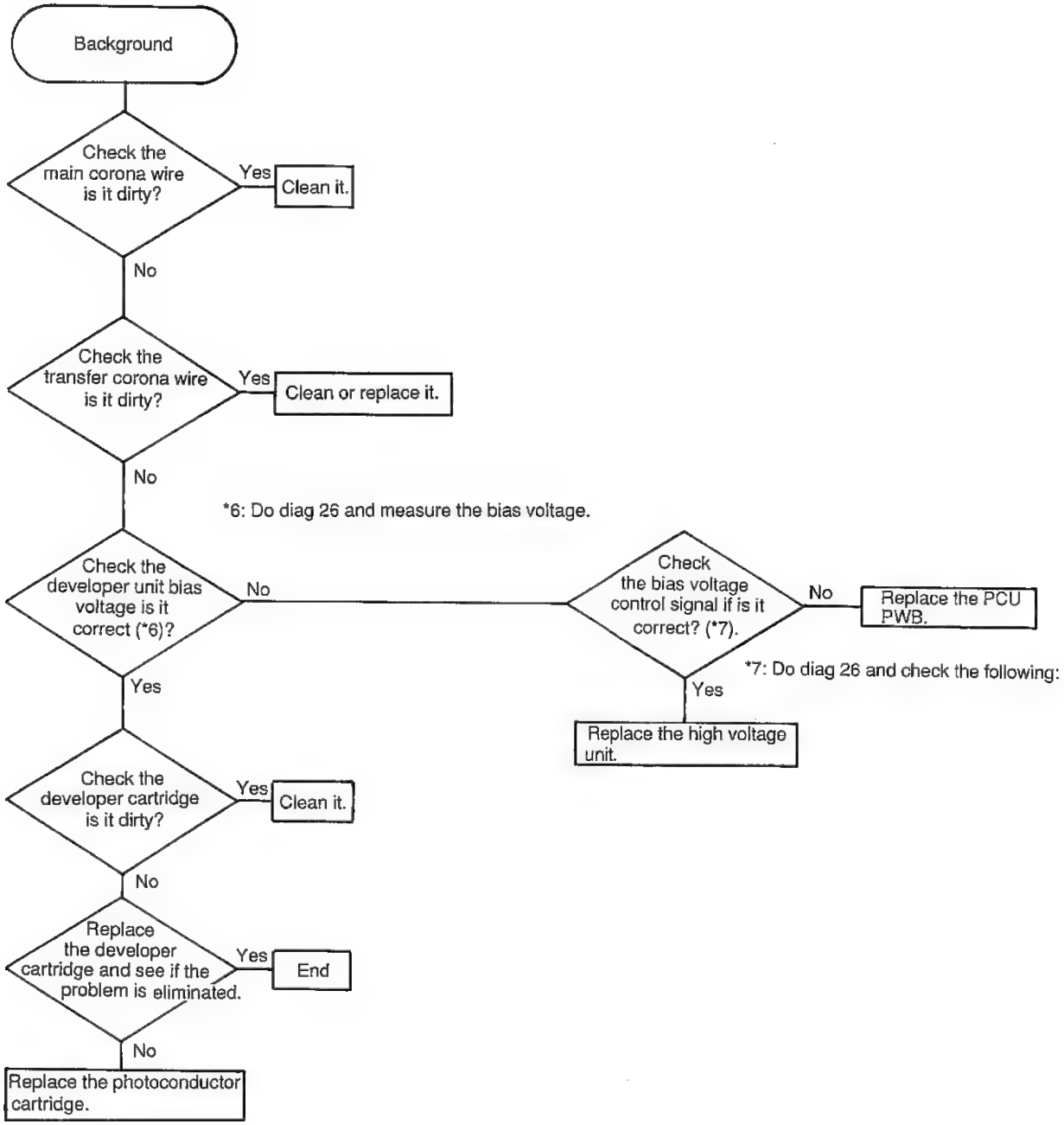
■ Printed image felt rough and toned image easily wiped away with your fingertip



NOTE: Black or white bands may appear in the paper feeding direction if it is an irregular corona discharge.

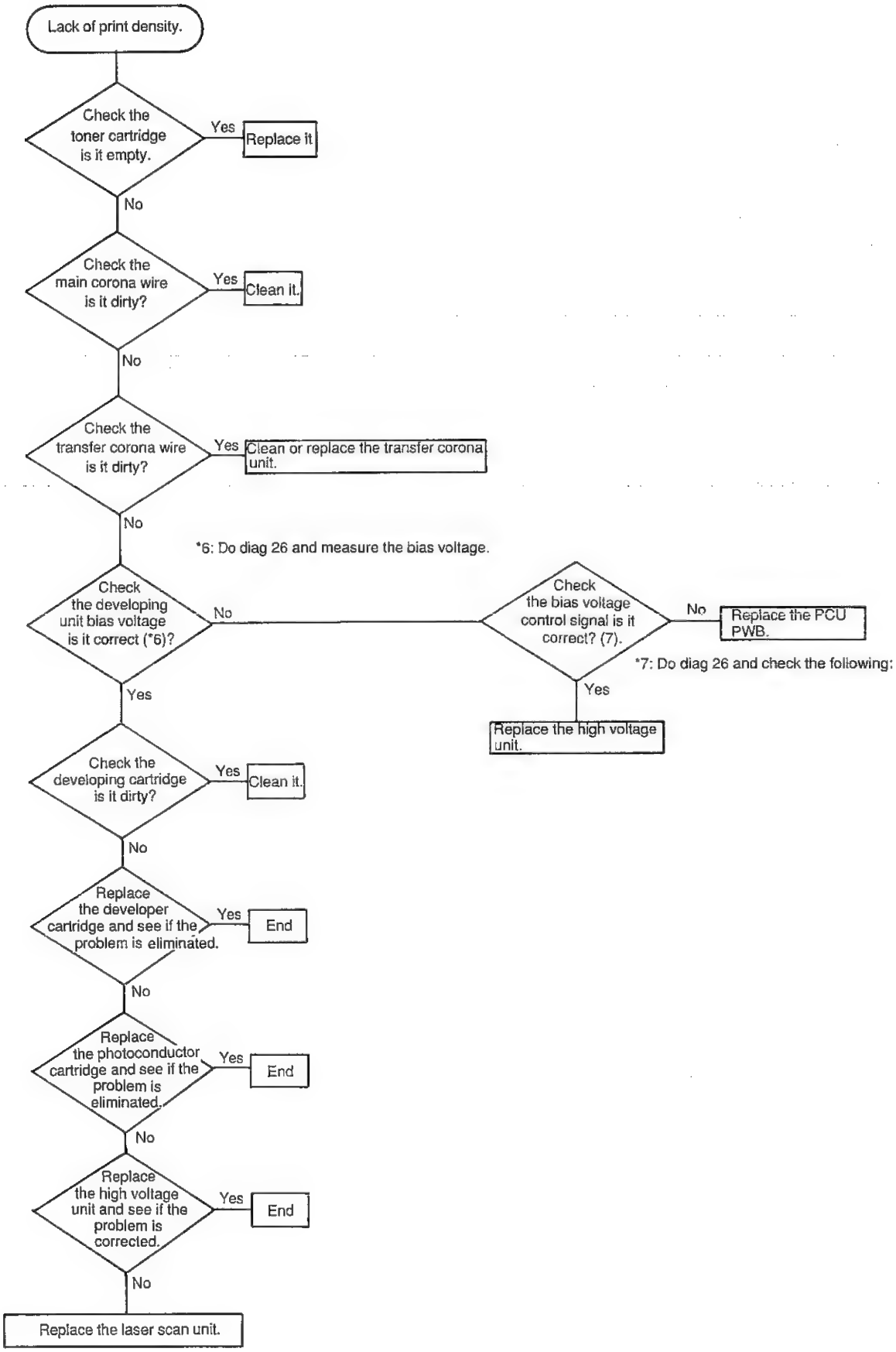
6. Background

■ Background copied on a part or on the entire area of print



7. Lack of print density

■ Extremely light print density



(B) Troubleshooting for error code

1. Error types

Operator call error

a. Door open "dO"
Indicates that either the face down stacker or the front door is open.
Close the door and push the CLEAR key to cancel error status.

b. Misfeed "PJ"
Indicates a paper misfeed inside the machine.
Remove the paper and push the CLEAR key to cancel error status.
If the door was left open to remove the paper, error status is canceled after the front door is closed without pushing the CLEAR key.

c. Paper empty "PO"
Indicates cassette paper empty.
Error status is canceled when the CLEAR key is pushed after replenishing paper in the cassette.

d. Toner cartridge replacement "CC"
Indicates toner empty or install the toner cartridge.
Replace the toner cartridge with a fresh one or install the toner cartridge. Then, push the CLEAR key to start supplying toner. If, the required toner concentration is not achieved within two minutes, the prompt "CC" is displayed again.

e. Photoconductor cartridge replacement "PC"
Indicates replace the Photoconductor cartridge.
When diag 04 is executed after replacing the drum cartridge with a new one, the normal operation resumes.

① Turn power on with the SELECT key depressed.

② Push the ∇ or Δ key to bring "04" on the display.

③ Push the PRINT switch.

f. Developer cartridge replacement "dL"
Indicates replace the developer cartridge.
Replace the developing cartridge with a new one, and execute diag 05 to return the printer to the normal operating condition.

① Turn power on with the SELECT key depressed.

② Push the ∇ or Δ key to bring "05" on the display.

③ Push the PRINT switch.

g. Overhaul "OH"
Indicates the period that the printer needs to be overhauled.

(NOTE)

When the above error occurs, the printer goes into the off-line mode.

Even after the error task is performed and the CLEAR key is pressed to clear the error, the printer will remain in the off-line mode.

To resume the operation, switch the mode to the on-line mode.

Servicer engineer call error

Work by the service engineer is required when one of the following errors is displayed.

a. P1 to P4
A fault in the PCU (process control unit).

b. C1 to C6
Printer mechanism fault.

c. E1 to E5
A fault in the ICU (interface control unit).

d. FC, IE
Other fault.

Operator call error

Error status	Error description
dO	Door open
PJ	Paper jam
PO	Paper out
CC	Toner cartridge empty
PC	Photoconductor life over
dL	Developer life over
OH	Overhaul
UO	User memory overflow
bO	Buffer overflow
OE	Overrun error

Service engineer call error

Error status	Error description
P1	PCU ROM sumcheck error
P2	PCU RAM read/write error
P3	NVRAM read error
P4	Serial communication error
C1	Fault in the optical system
C2	Fault in the main motor
C3	Fault in the polygonal motor
C4	Heater high temperature error
C5	Heater low temperature error
C6	Thermistor open error
E1	ICU ROM sumcheck error
E2	ICU RAMread/write error
E3	Expansion memory read/write error
E4	ICU hardware error
E5	ICU NVRAM sumcheck error
FC	Font cartridge error
IE	Interface error

2. Error check point

	Cause	Error description		Action
DO	Door open	1) Check the facedown cover if not open.	Yes	Close the facedown cover.
		2) Check the front cover if not open.	Yes	Close the front cover.
		3) Check the facedown cover switch if it operates normally.	No	Replace the facedown cover switch with a new one.
		4) Check the front door switch if it operates normally.	No	Replace the front door switch with a new one.
		5) Check the facedown cover actuator arm if it operates normally.	No	Replace the actuator arm (at the end of the guide) with a new one.
		6) Check the front door actuator arm if it is not damaged.	No	Replace the front door with a new one.
		7) Open and close the front door with the facedown cover closed and check pin 9 of IC5(LS153) if it changes from low to high, when pins 14 and 2 are at a high.	No	Failure in IC5(LS153). Contact failure.
PJ	Misfeed	1) Check the machine for paper.	Yes	Remove the paper.
		2) Check the paper detect sensor, if normal.	No	Replace the paper detect sensor.
		3) Turn on and off the leadswitch and check that the following signals turn from high to low, a. when pins 14 and 2 of IC5(LS153) are at a low. Paper entry sensor . . . . . Check pin 7 of IC5(LS153) if it turns from high to low. Paper exit sensor . . . . . Check pin 9 of IC5(LS153) if it turns from high to low. b. when pin 14 of IC5 (LS153) is at a high and pin 2 of IC5 (LS153) is at a low. Hand feed entry sensor . . Check pin 7 of IC5 (LS153) if it turns from high to low. c. when pin 14 of IC5 (LS153) is at a low and pin 2 of IC5 (LS153) is at a high. Face down exit sensor . . . Check pin 7 of IC5 (LS153) if it turns from high to low.	No	Failure in IC5(LS153) Contact failure Failure in the leadswitch
PO	Paper out	1) Check the paper cassette, if empty.	Yes	Replenish paper in the cassette.
		2) Turn on and off the paper entry sensor and check to see if pin 7 of IC5(LS153) turns from low to high, when pins 14 and 2 of IC5(LS153) are at a low.	No	Failure in IC5(LS153) Contact failure Failure in the microswitch
P1	PCU ROM Sumcheck error	Check the CPU if the correct one is used.	Yes	Replace the CPU(HD63A01Y0P) with a new one.
P2	PCU RAM read/writ error	Check the CPU if the correct one is used.	Yes	Replace the CPU(HD63A01Y0P) with a new one.
P3	NVRAM read error	1) Check the CPU, if operating normally. Check CE and SK received at power on.	No	Replace the CPU(HD63A01Y0P) with a new one.
			Yes	Replace IC6(S2444R) with a new one.
C1	Optical system failure	1) Check $\overline{\text{START}}$ if received correctly.	No	Replace IC9(LS07) with a new one.
		2) Check BD if issued properly.	No	Replace IC8(LS14) with a new one.
		3) Check $\overline{\text{BD}}$ if issued properly.	No	Replace the optical unit with a new one.
C2	Main motor failure	1) Check +24V if properly supplied.	No	Replace the power supply unit with a new one.
		2) Check $\overline{\text{MMD}}$ if properly received when the motor is on.	No	Replace IC9(LS07) with a new one.
		3) Check $\overline{\text{MMTLK}}$ if properly received when the motor is on.	No	Replace the motor with a new one.
C3	Polygonal motor failure	1) Check +24V if properly issued.	No	Replace the power supply with a new one.
		2) Check $\overline{\text{PMD}}$ if correctly received when the polygonal motor is on.	No	Replace IC3(UPA2204C) with a new one.
		3) Check $\overline{\text{PMTLK}}$ if issued properly when the polygonal motor is on.	No	Replace the optical unit with a new one.
C4	Irregularly high heater temperature	1) Check the resistance across the thermistor if 100kilohms at room temperature of 25°C.	No	Replace the thermistor with a new one.
		2) Check $\overline{\text{HTH}}$ if high under room temperature of 25°C.	No	Replace IC13(UPC393G) with a new one.
		3) Check $\overline{\text{HLON}}$ if properly issued, not always at a low.	No	Replace IC3(UPA2004C) with a new one.
		4) Check the PC1 phototriac within the power supply unit if operating normally.	No	Replace PC1(TLP666JF) with a new one.

	Cause	Error description		Action
C5	Irregularly low heater temperature	1) Check the resistance across the thermistor if 100kilohms at room temperature of 25°C.	No	Replace the thermistor with a new one.
		2) Check WT is at a high during warmup.	No	Replace IC12(UPC358G) with a new one.
		3) Check $\overline{\text{HLON}}$ if at a low during warmup.	No	Replace IC3(UPA2004C) with a new one.
		4) Check P1 phototriac is it on during warmup.	No	Replace PC1(TL-666JF) with a new one.
		5) Check the heater wire and thermostat if not open.	No	Replace the heater with a new one or push the thermostat manual reset button..
C6	Open thermistor	1) Check the resistance across the thermistor if 100kilohms at room temperature of 25°C.	No	Replace the thermistor with a new one.
			Yes	Replace IC13(UPC393G) with a new one.
E1	ICU ROM sumcheck error	1) Check the ROM chip if correct.	No	Replace the ROM chip with a new one.
E2	ICU RAM read/write error	1) Check the RAM chip if correct.	No	Replace the RAM chip with a new one.
E3	Expansion memory read/write error	1) Check the expansion memory if correct.	No	Replace the expansion memory with a new one.
E4	ICU hardware error			Replace the ICU with a new one.
E5	ICU NVRAM sumcheck error	1) Check the NVRAM if correct.	No	Replace the NVRAM chip with a new one.
P4	Serial communication error	1) Check pin 8 of IC8(LS14) if the correct signal is issued.	No	Replace IC8(LS14) with a new one.
		2) Check pin 37 of IC10(PCUGA) if the correct signal is issued.	No	Replace IC10(PCUGA) with a new one.

[13] Process control unit (PCU) circuit description

The PCU consists of the following circuits:

1. CPU peripheral circuit
2. ICU interface circuit
3. Print control peripheral circuit
4. OPU control circuit
5. Print process control circuit

BLOCK DIAGRAM

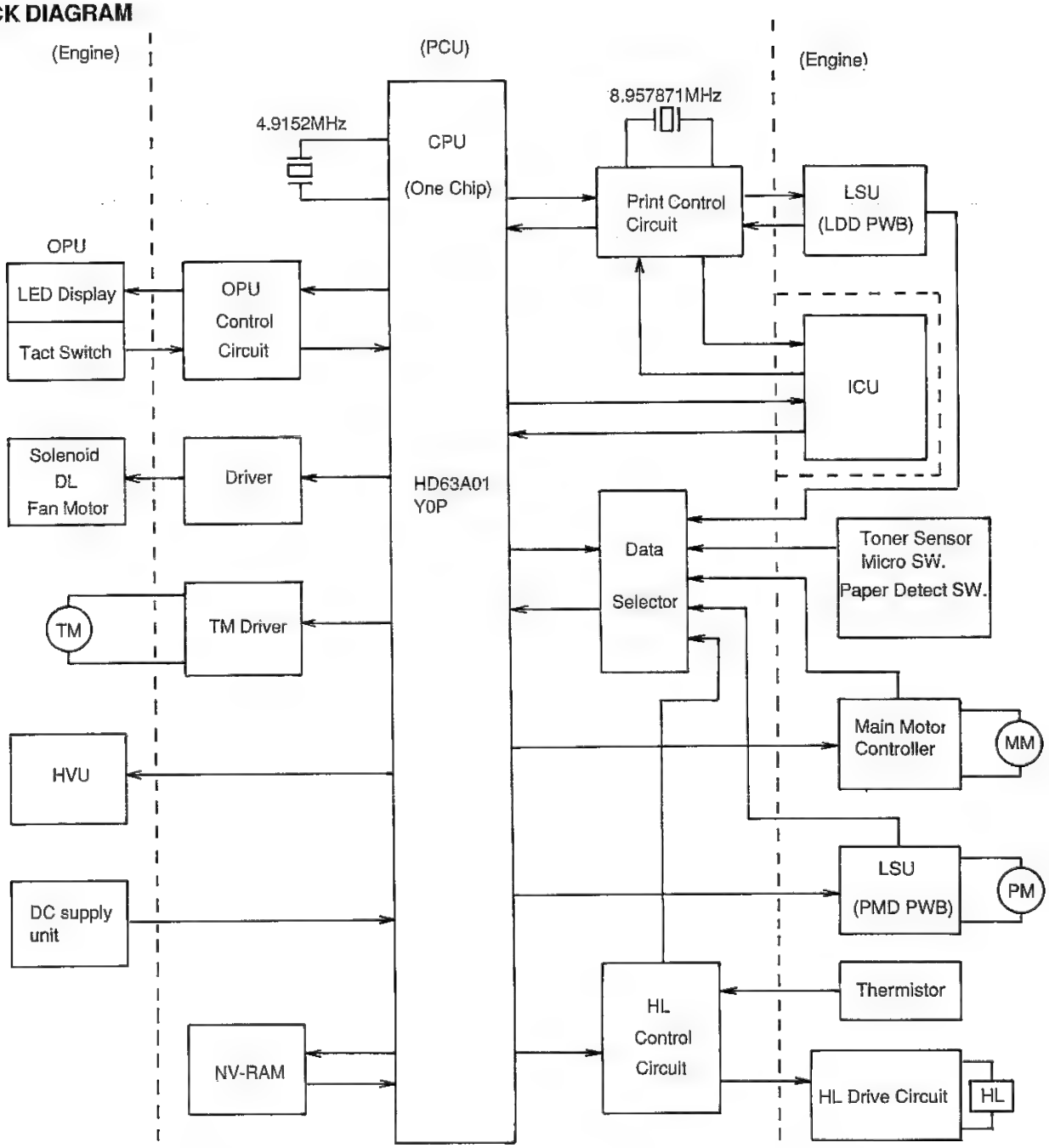


Fig. 1

Legend:-

LSU:	Laser scanning unit	OPU:	Operation unit
PCU:	Process control unit	TM:	Toner motor
LDD PWB:	Laser diode drive printed wire board	DL:	Discharge lamp
PMD PWB:	Polygonal motor drive printed wire board	HVU:	High voltage unit
HL:	Heater lamp	ICU:	Interface control unit

1. CPU peripheral circuit

The HD63A01YOP single chip microcomputer is used in the single chip mode by the PCU and the on-chip memory area is used for program memory and work RAM.

Backup data is saved in the external NVRAM (Non-Volatile RAM) which is accessed at power on and power off.

1-1. CPU

The HD63A01YOP is used as a mechanism (printer engine) controller and a video interface controller with the ICU (interface control unit).

The HD63A01YOP 8-bit CMOS single chip microcomputer incorporates a CPU, 16KB ROM, 256B RAM, four functional 16-bit timer, 8-bit reloadable timer, serial communication interface, and 53 parallel I/O lines.

The PCU operates the CPU in the MODE-3 single chip mode.

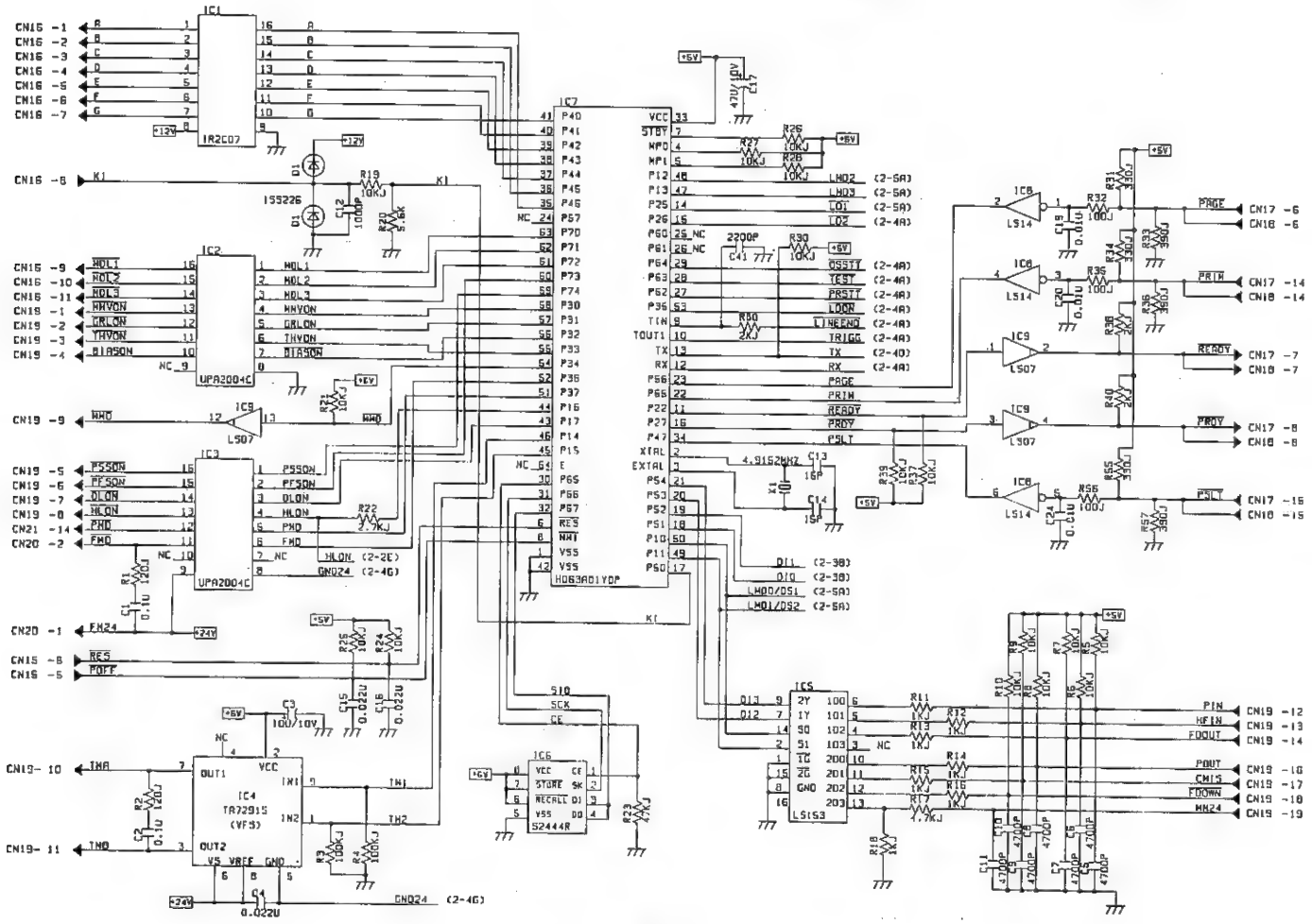


Fig.2

CPU Termnal arrangement

Pin No.	In/Out	Signal name	Function
1	–	–	GND (0V)
2 – 3	–	–	Clock pulses
4 – 5	–	–	Pull up to 5V
6	In	$\overline{\text{RES}}$	CPU reset signal
7	–	–	Pull up to 5V
8	In	$\overline{\text{POFF}}$	Power off detect signal.
9	In	$\overline{\text{LINEEND}}$	Line end signal from print control circuit.
10	Out	TRIGG	Laser diode emit signal to print control circuit.
11	Out	$\overline{\text{READY}}$	Print ready signal to ICU. "L" for ready to print.
12	In	CMD (RX)	Command signal from ICU via IC10.
13	Out	STS (TX)	Status signal to ICU.
14	Out	$\overline{\text{LD1}}$	Left margin data load signal to print control circuit.
15	Out	$\overline{\text{LD2}}$	Left margin data load signal to print control circuit.
16	Out	$\overline{\text{PRDY}}$	PCU ready signal to ICU. "L" for ready to communicate with the ICU.
17	In	KI	Key input signal. Depressed key is detected by matrix circuit with segment signal.
18 – 21	In	DI0 – 3	Data signal from data selector.
22	In	PRIM	Initialize request signal from ICU.
23	In	PAGE	Print start request signal from ICU.
24 – 26	–	–	N.C
27	Out	$\overline{\text{PRSTT}}$	Print start signal. When this signal "L" HSYNC and CLK issued to ICU.

Pin No.	In/Out	Signal name	Function
28	Out	$\overline{\text{TEST}}$	Print test data in the diagnostic mode.
29	Out	$\overline{\text{OSSTT}}$	Start signal to the print control circuit.
30	Out	CE	Chip enable signal to NVRAM.
31	Out	SCK	Clock signal to NVRAM.
32	In/Out	SIO	Data signal between NVRAM and CPU.
33	–	–	VD (+5V)
34	–	–	Not used.
35 ~ 41	Out	A ~ G	Segment control signal
42	–	–	GND (0V)
43	Out	DLON	Discharge lamp (DL) control signal. DL is turned on by high level.
44	Out	HLON	Heater lamp (HL) control signal. HL is turned on by high level.
45, 46	Out	TM1, TM2	Toner motor (TM) control signal. TM is turned on by pulse signal.
47	Out	LMD3	Left margin data signal.
48	Out	LMD2	Left margin data signal.
49	Out	LMD1/DS2	Left margin data signal/Data selector signal
50	Out	LMD0/DS1	Left margin data signal/Data selector signal
51	Out	PMD	Polygonal motor (PM) control signal. PM is turned on by high level.
52	Out	FMD	Cooling fan motor (CFM) control signal. CFM is turned on by high level.
53	Out	$\overline{\text{LDON}}$	Laser diode activating signal. Used to force the laser diode to emit beam.
54	Out	$\overline{\text{MMD}}$	Main motor (MM) control signal. MM is turned on by low level.
55	Out	THVON	Transfer corona control signal. Transfer corona is turned on by high level.
56	Out	$\overline{\text{BIASON}}$	DV Bias control signal. DV Bias is turned on by low level.
57	Out	GRLON	Screen grid bias control signal.
58	Out	MHVON	Main corona control signal. Main corona is turned on by high level.
59	Out	PSSON	Paper stop solenoid (PSS) control signal. PSS is turned on by high level.
60	Out	PFSON	Paper feed solenoid (PFS) control signal. PFS is turned on by high level.
61 – 63	Out	MDL1 ~ 3	Display common signal. Lighting up display elements by matrix circuit with segment control signal.
64	–	–	N.C

1-2. Non-volatile RAM (NVRAM)

The S2444R is a 256-bit non-volatile CMOS RAM which consists of 16 words x 16 bits. Data is transferred via single serial data bus.

Every bit of this RAM is backed up by an electrically erasable non-volatile memory (E^2PROM). Data transfer between the RAM and the E^2PROM takes place by a command from the processor, $\overline{\text{STORE}}$, and $\overline{\text{RECALL}}$. (In the case of the PCU, a command from the processor is used.)

While the non-volatile data is stored in the E^2PROM, the RAM data is used for read and write. It does not require high voltage pulse and power supply, only a single +5V supply is required. All inputs and outputs are TTL compatible.

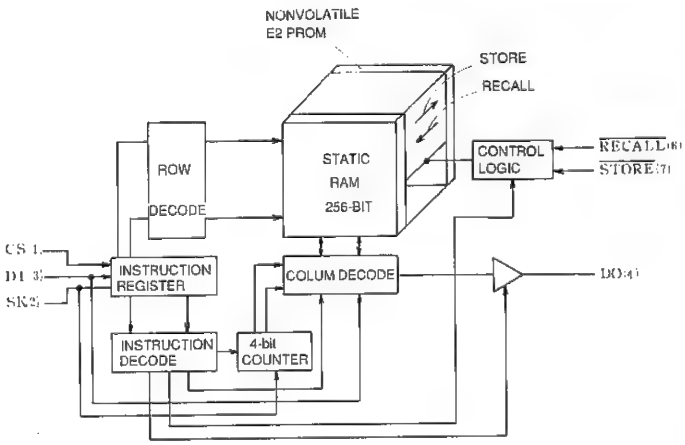


Fig. 3 S2444R (16X16) Block Diagram

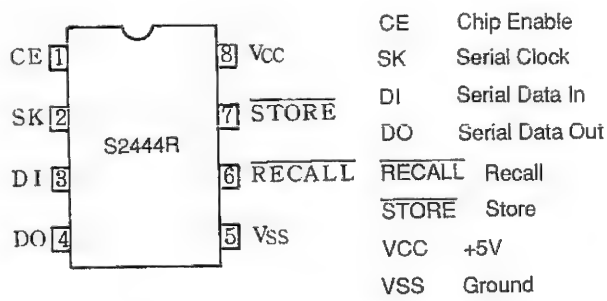


Fig. 4 Pin Configuation and Names

The NVRAM stores the following:

(1) Life counter content

(2) Top margin and left margin

(3) Sleep mode or normal mode

(4) Error content when power is turned off.

INSTRUCTION SET	
Instruction	Operation
WRDS	Reset Write Enable Latch (Disables writes and stores)
STO	Store RAM data in E2PROM
SLEEP	Enter SLEEP Mode
WRITE	Write Data into RAM Address AAAA
WREN	Set Write Enable Latch (Enables writes and stores)
RCL	Recall E2PROM Data into RAM
READ	Read Data from RAM Address AAAA

Table 1

(1) Recall

When recall is commanded, the data in the non-volatile E^2PROM are transferred to the RAM.

(2) Store

When store is commanded, the data in the RAM is transferred in the E^2PROM to revise the data within the E^2PROM.

(3) Read/write memory

The RAM is accessed with a READ or WRITE command.

1-3. PCU power on/off sequence

The figure below shows the power on/off sequence of the CPU.

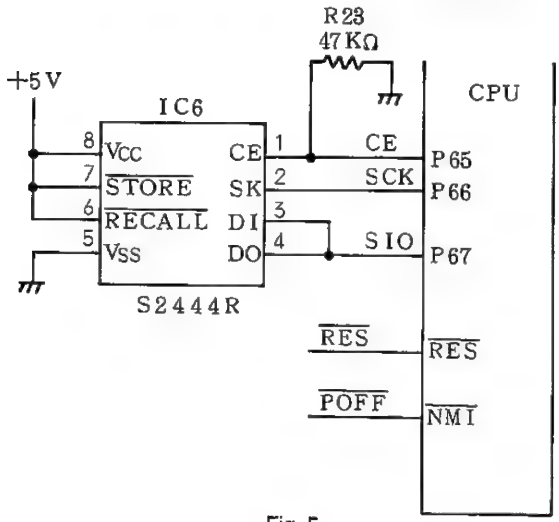


Fig. 5

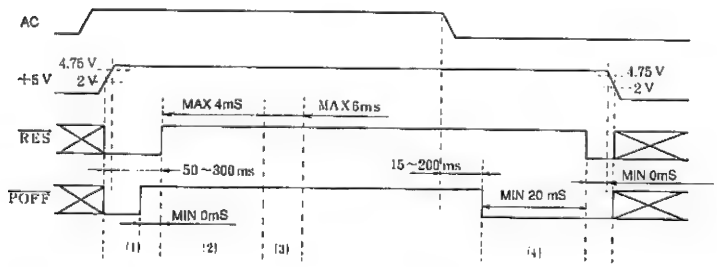


Fig. 6

(1) After the AC power is turned on, both $\overline{RES}$ and $\overline{POFF}$ are set low for more than the prescribed period when the +5V line is above 2V.

(2) After $\overline{RES}$ is reset to high, the CPU starts executing the program to perform a series of operations; initializing ports, checking ROM and RAM, clearing RAM, and a series of initialize operations.

(3) After (2) has been completed, the CPU accesses the NV-RAM. With the execution of an RCL command, data within the E^2PROM are transferred to the RAM in the NV-RAM. As a READ command is executed next, the RAM data in the NV-RAM are transferred to the work RAM within the CPU.

(4) When the AC power is turned off, $\overline{POFF}$ is issued from the DC power supply and the CPU executes the non-maskable interrupt. The CPU turns off, loads and transfers the backup data to the NV-RAM in this interrupt. As the write command is executed, the data in the work RAM is transferred to the RAM in the NV-RAM. As the STO command is executed next, the RAM data in the NV-RAM are sent to the E^2PROM in the NV-RAM to save the data against power off.

2. ICU interface circuit

The interface between the ICU and the PCU is called a video interface whose configuration is shown in Fig. 7. All signals are LS-TTL level and its I/O circuit is shown in Fig. 8.

The following are two kinds of video interfaces.

(1) Serial interface

(2) Single line signal

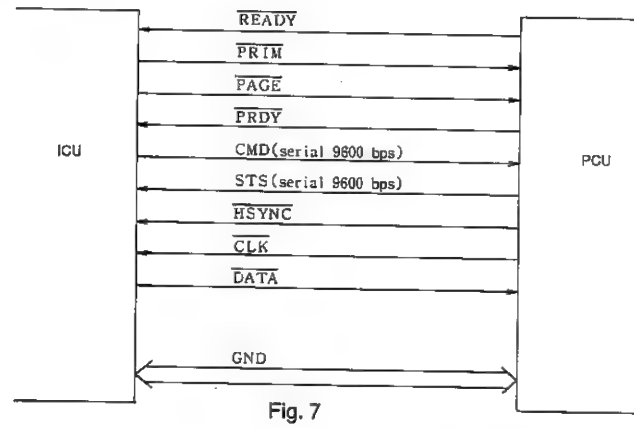


Fig. 7

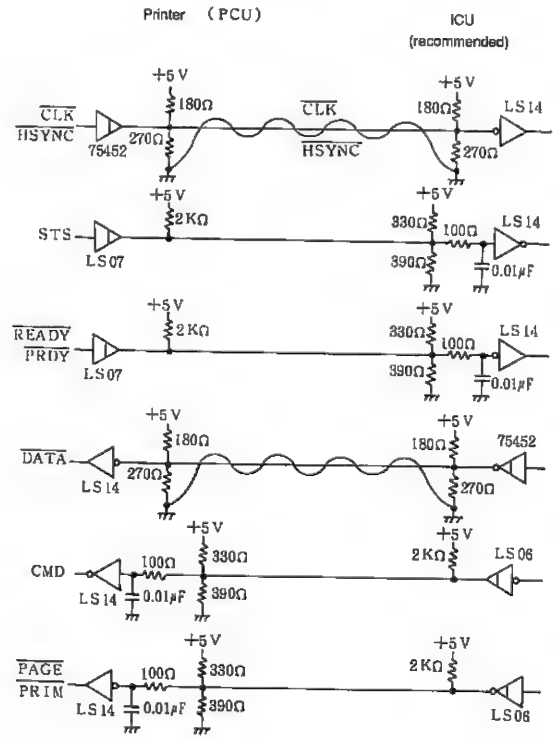


Fig. 8

2-1. Serial interface

CMD and STS are the serial lines used to exchange control information between the PCU and the ICU.

The ICU requests the PCU to perform various operational and status information via the CMD line and OPU (operational unit) and printer engine related status information from the PCU via the STS line.

NOTES:

(1) STS: Status line (from PCU to ICU)

CMD: Command line (from ICU to CPU)

(2) Serial interface hardware specifications

Baud rate: 9600bps

Character length: 8 bits

Start bit: 1 bit

Stop bit: 1 bit

Parity bit: none

System: Full duplex, async

For the HD63A01Y0P internal serial interface circuit is used for the serial interface of the PCU, CMD is processed by the interrupt program routine upon completing reception of one byte.

In order that the ICU may send control and status codes, a minimum 5ms interval is needed for sending two single-byte codes. This is because the PCU samples a code once per 5ms, and the PCU also sends to the ICU control and status code, at 5ms interval per byte.

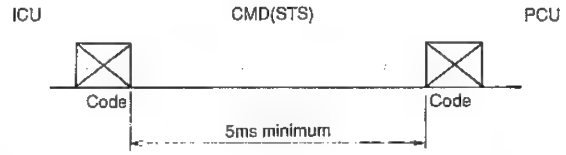


Fig. 9

Table 2. Control code exchange procedure 1/3

CONTROL CODE		PROCEDURE			FUNCTION
HD*	NAME	ICU	LINE	PCU	
80 +	SSA	80	→		Status Sense A. ICU reads status A from PCU.
			←	80,STSA	
81 +	SSB	81	→		Status Sense B. ICU reads status B from PCU.
			←	81,STSB	
82 +	SSC	82	→		Status Sense C. ICU reads status C from PCU.
			←	82,STSC	
83 +	SSD	83	→		Status Sense D. ICU reads status D from PCU.
			←	83,STSD	
84	LEDR	84	→		LED Status Read. ICU reads status of LED lights on control panel.
			←	84,LEDS	
85	SGLR	85	→		7-Segment Lower Digit Status Read. ICU reads status of lower digit segments of LED display on control panel.
			←	85,SGLS	
86	SGHR	86	→		7-Segment Higher Digit Status Read. ICU reads status of higher digit segments of LED display on control panel.
			←	86,SGHS	

* : Control code in 2-digits hexadecimal number.

+ : Important control code.

LINE: → for CMD line, and ← for STS line.

Table 3. Control code exchange procedure 2/3

CONTROL CODE		PROCEDURE			FUNCTION
HD*	NAME	ICU	LINE	PCU	
87	SWR	87	→		Switch Status Read. ICU reads status of switches on control panel.
			←	87,SWS	
90 +	SWSCHG		←	90,SWS	Switch Status Changed. PCU sends switch status to ICU when there is a status change of switches on control panel.
92 +	PCUERR		←	92	PCU Error. This code indicates error detection in PCU.
A0 +	SGLON	A0,SGLS →			7-Segment Lower Digit On. PCU turns on lower digit segments of LED display according to SGLS.
A1 +	SGHON	A1,SGHS →			7-Segment Higher Digit On. PCU turns on higher digit segments of LED display according to SGHS.
A2 +	LEDON	A2,LEDS →			LED Indicator On. PCU turns on LED lights according to LEDS.

* : Control code in 2-digits hexadecimal number.

+ : Important control code.

LINE: → for CMD line, and ← for STS line.

Table 4. Control code exchange procedure 3/3

CONTROL CODE		PROCEDURE			
HD*	NAME	ICU	LINE	PCU	FUNCTION
A3	PMSTT	A3	→		Polygon Motor Start. Polygon motor is also started by PAGE signal.
A4 +	PERST	A4	→		PCU Error Reset. PCU resets PCU errors that are resettable.
B1	LEDBK	B1,LEDS	→		Operation Panel LED Blinking Start.
B2	SGHBK	B2	→		Operation Panel High digit segment Blinking Start.
B3	SGLBK	B3	→		Operation Panel Low digit segment Blinking Start.
B4	SGBKOFF	B4	→		Operation Panel High, Low digit segment Blinking Stop.

* : Control code in 2-digits hexadecimal number.

+ : Important control code.

LINE: → for CMD line, and ← for STS line.

Table 5. Status codes, STSA to STSD

Bit	STSA, PCU Status	STSB, Operator Call	STSC, Hardware Error (1)	STSD, Hardware Error (2)
D7	0	0	0	0
D6	Warm-up	Toner Empty	PCU ROM Error	Optical System Error
D5	Operator Call	Paper Out	PCU RAM Error	Main Motor Defective
D4	Hardware Error (1)	Paper Jam	NV-RAM Error	Plgn Motor Defective
D3	Hardware Error (2)	Door open	0	Heater High Temperature
D2	Manual Feed SW ON	Photoconductor Cartridge Life Over	0	Heater Low Temperature
D1	PCU Diagnostic Test	Developer Cartridge Life Over	0	Thermistor Open
D0	Facedown Mode ON	Overhaul (refurbish)	0	0

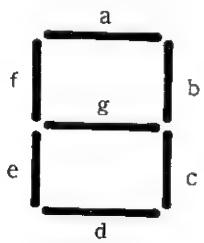
Logic One (1) for Set, and Logic Zero (0) for Reset.

Table 6. Status codes: LEDS, SGLS, SGHS and SWS.

Bit	LEDS, LED Light Status	SWS, Switch Status	SGHS, High Digit Seg. Status	SGLS, Low Digit Seg. Status
D7	0	0	0	0
D6	READY	0	a	a
D5	ERROR	SELECT	b	b
D4	PRINT	LINE	c	c
D3	LINE	△	d	d
D2	TEST	▽	e	e
D1	SET	CLEAR	f	f
D0	POWER	PRINT	g	g

Logic One (1) for switch ON or LED Light/segment lit;

Logic Zero (0) for switch OFF or LED light/segment OFF.



Segments of LED Display Digit

2-2. Single line signal

As mentioned STS and CMD are used to do serial signal transfer between the PCU and the ICU, but, the following single line signal is also used.

(1) Print control signals

$\overline{\text{PRDY}}$

$\overline{\text{READY}}$

$\overline{\text{PRIM}}$

(2) Print related signals

$\overline{\text{PAGE}}$

$\overline{\text{HSYNC}}$

$\overline{\text{CLK}}$

$\overline{\text{DATA}}$

Those are print related signals and will be discussed in more detail in Para 3-3, "Print control circuit".

Table 7 gives functional description of the video interface signals.

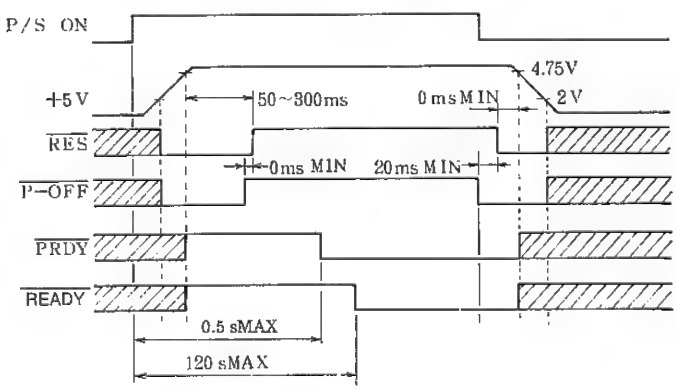
Table 7. Functions of interface signals

SIGNAL	DIRECTION	FUNCTION
$\overline{\text{PRDY}}$	ICU ← PCU (PCU Ready)	L for ready to communicate with the ICU. When this signal is H, all signals, including CMD and STS, are ignored.
$\overline{\text{READY}}$	ICU ← PCU (Ready)	L for ready to print. H for warm-up, error detected or printer busy.
$\overline{\text{PRIM}}$	ICU → PCU (Prime)	Initialize request to PCU. Active L state. When the printer is busy, this request is held until one page printing is completed.
$\overline{\text{PAGE}}$	ICU → PCU (Page)	Print start request to PCU. It should be L during transmission of one pageful of data. When this signal is received and providing that there is no error, PCU will start operation.
$\overline{\text{HSYNC}}$	ICU ← PCU (Horizontal Sync)	Sync signal for line-by-line printing. This signal indicates start timing of each line.
$\overline{\text{CLK}}$	ICU ← PCU (Clock)	Synchronization clock for print video data receiving. ICU, after receiving an HSYNC pulse, sends video data in synchronization with this clock.
$\overline{\text{DATA}}$	ICU → PCU (Data)	Print video data line. L level for black and H level for white. To be kept H after transmission of one line of data.
CMD	ICU → PCU (Command)	Command sending line to PCU. ICU sends various commands to PCU through this line.
STS	ICU ← PCU (Status)	Status sending line from PCU. ICU receives status information from PCU through this line.

2-3. Description about $\overline{\text{PRDY}}$, $\overline{\text{READY}}$, and $\overline{\text{PRIM}}$

(1) Power on sequence

Power-On Sequence and Initialize Request



After initializing the circuits (RAM clear, etc.) at power on, $\overline{\text{PRDY}}$ is set low to inform that the interface between the ICU and the PCU is ready, except for the print process block.

On the other hand, $\overline{\text{READY}}$ goes low upon completing the warmup process which normally requires 60 seconds. However, if the toner is near empty or completely empty, warmup time will be extended to 120 seconds at a maximum for adjusting the toner concentration.

(2) Prime process sequence

Prime Processing Sequence

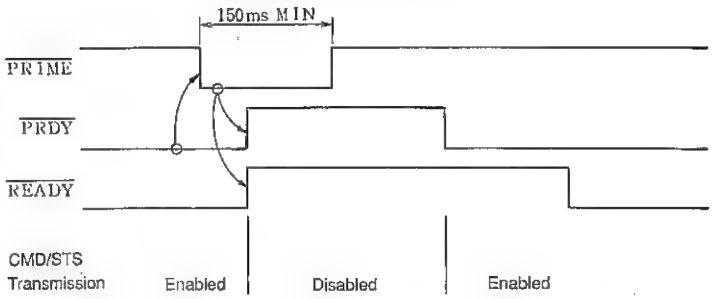


Fig. 11

Sequence:

(1) After checking that CMD is not being sent and $\overline{\text{PRDY}}$ is at a low, the ICU sends $\overline{\text{PRIM}}$ to the PCU. Note that a minimum 150ms is required for the $\overline{\text{PRIM}}$ pulse width.

(2) Having received $\overline{\text{PRIM}}$, the PCU sets $\overline{\text{PRDY}}$ and $\overline{\text{READY}}$ high at a timing that STS is not being sent. It would not be necessary for the PCU to send back with STS in response to the last CMD from the ICU.

(3) After initialization of the circuit, the PCU sets $\overline{\text{PRDY}}$ low.

(4) The PCU sets $\overline{\text{READY}}$ low when the print sequence becomes ready.

NOTES: 1. The CPU is enabled to receive $\overline{\text{PRIM}}$ only when $\overline{\text{PRDY}}$ is low.

2. The ICU must send $\overline{\text{PRIM}}$ at the time the power is turned on to the ICU. A serial communication error might be evoked unless the ICU sent $\overline{\text{PRIM}}$.

3. If $\overline{\text{PRIM}}$ was received during printing process, the circuit is initialized after completing the present print cycle.

4. Normally, error is canceled by PERST CMD (PCU error reset command) from the ICU, but $\overline{\text{PRIM}}$ may be used instead.

3. Print control peripheral circuit

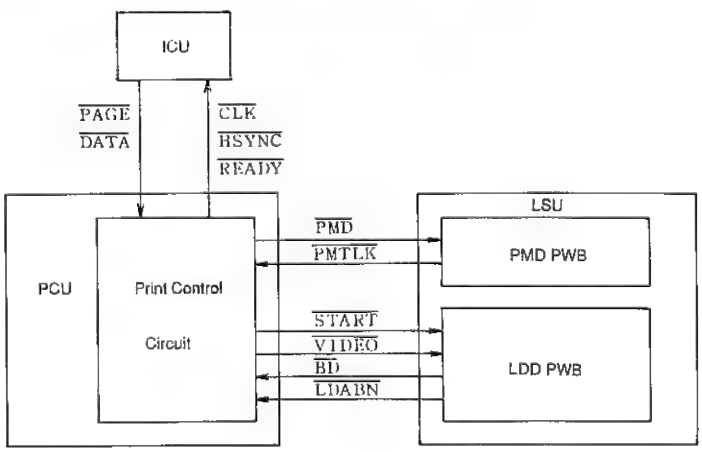


Fig. 12

The ICU interrogates $\overline{\text{READY}}$ if the print sequence is ready. If ready, $\overline{\text{PAGE}}$ is issued to th PCU to start printing. Upon receiving $\overline{\text{PAGE}}$, the CPU starts the printer engine and the LSU, and, at the appropriate timing, $\overline{\text{CLK}}$ and $\overline{\text{HSYNC}}$ are sent to the ICU. The ICU then issues to the PCU the print data as $\overline{\text{DATA}}$ in sync with the sync clock $\overline{\text{CLK}}$. The PCU sends the print data to the LDD (laser diode drive) PWB in reference to $\overline{\text{BD}}$ (basic signal to scan laser beam) received from the LSU to scan the drum surface with laser beam.

3-1. Print control outline

3-1-1. Print area

The effective print area on the paper is smaller than the actual paper size because there are marginal void areas. Void area of 1/4" is required for both side margins and 1/5" for top and bottom margins.

The print control circuit of the PCU functions that control transmit timing of the sync signals ($\overline{CLK}$, $\overline{HSYNC}$) which are sent to the ICU for the print data to be correctly printed within the effective print area of the paper.

The left margin is set by adjusting the $\overline{CLK}$ transmit timing based on the laser beam start point detect signal $\overline{BD}$, (that is the distance "ℓ" in Fig.20 is adjusted). For the paper whose width is 8.5" (letter or legal size), the first bit comes 1/4" inside the edge of the paper (beginning of the effective print area). But, for those having smaller width, a "n — 1" bits must be skipped as blank from the real first bit according to the paper size because those papers are transported within the machine in reference to the right edge of the paper.

The top margin is established by adjusting the $\overline{HSYNC}$ transmit timing which is supplied to the ICU.

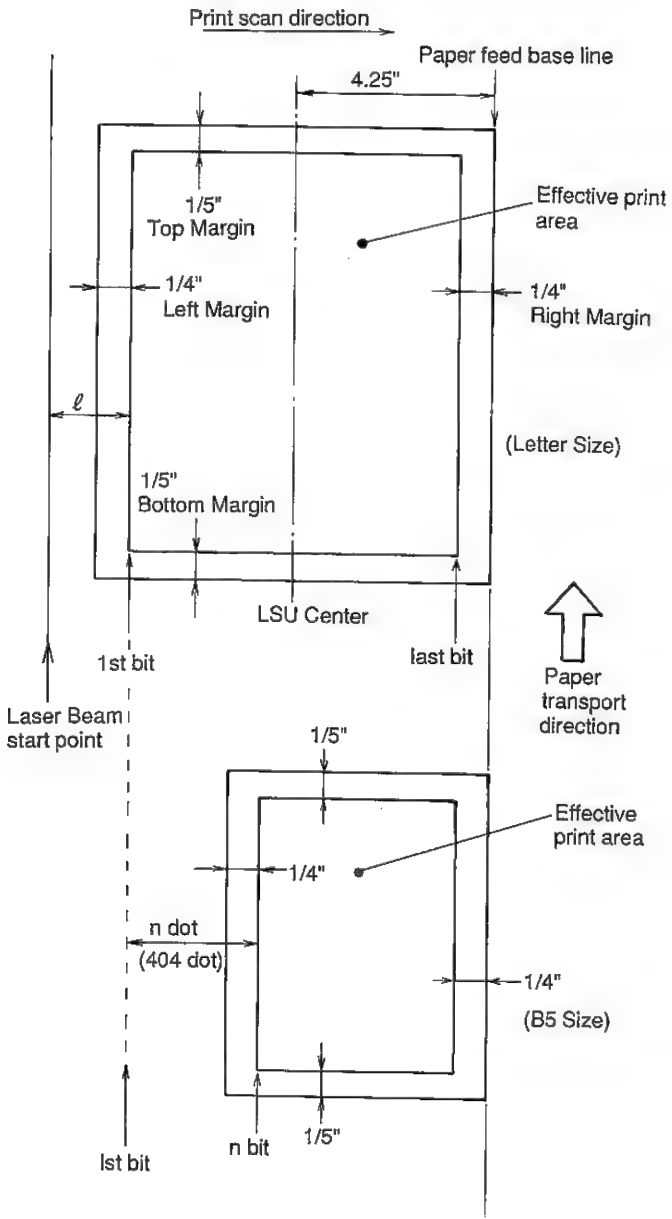


Fig. 13 Printing Area

Paper Size	n dot
letter	0
legal	0
A4	70
B5	404

Tab. 8

3-1-2. Laser beam scan

The data from the ICU is scanned at approximately 6000 lines maximum. Lines are counted within the PCU and the top margin is established based on a number of scans.

3-2. Laser scan unit (LSU)

(1) Unit base
(2) Collimator lens assy
(3) Polygonal mirror
(4) Fθ lens assy
(5) Reflect mirror
(6) Trigger mirror
(7) BD PWB (photodiode)
(8) LD PWB (laser diode)
(9) LDD PWB
(10) Polygonal motor PMD PWB

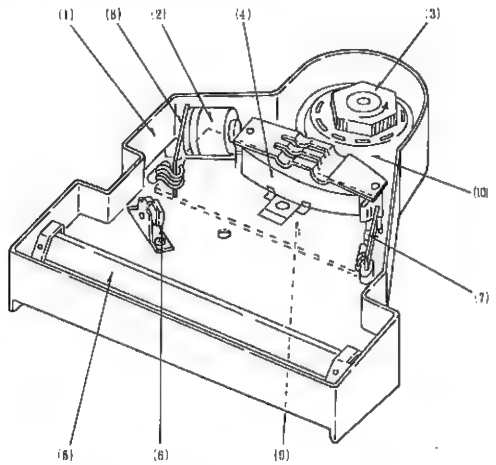


Fig. 14

NOTE: Dont remove the optical unit cover.

The LSU is controlled by the PCU.

A Laser beam is generated to form on the OPC drum a static latent image of the print data sent from the PCU.

The following are used for the LSU control signals.

(1) $\overline{START}$

A low on this line causes the optical control circuit to activate. The signal is at a high when the polygonal motor is stopped. The signal must be set low after or at the same time $\overline{VIDEO}$ went low.

(2) $\overline{VIDEO}$

A low on this line causes the laser diode to emit a beam.

(3) $\overline{BD}$ (beam detect)

A Laser beam is detected at a high to low transition of this signal.

(4) $\overline{LDABN}$ (laser diode abnormal)

When an abnormal current is supplied to the laser diode because of the exhaustion of the laser diode or irregular control, this signal is forced low. The signal turns high with a high state of $\overline{START}$.

(5) $\overline{\text{PMD}}$ (polygonal motor drive)

The polygonal motor starts with a low state of this signal and stops with a high state of the signal.

(6) $\overline{\text{PMTLK}}$ (polygonal motor lock)

PLL sync complete signal.

Low: Sync rotation

High: Async rotation

It requires 10 seconds, max., before $\overline{\text{PMTLK}}$ becomes low after $\overline{\text{PMD}}$ is set low.

3-2-1. Laser diode drive PWB (LDD PWB)

Laser diode drive circuit block diagram

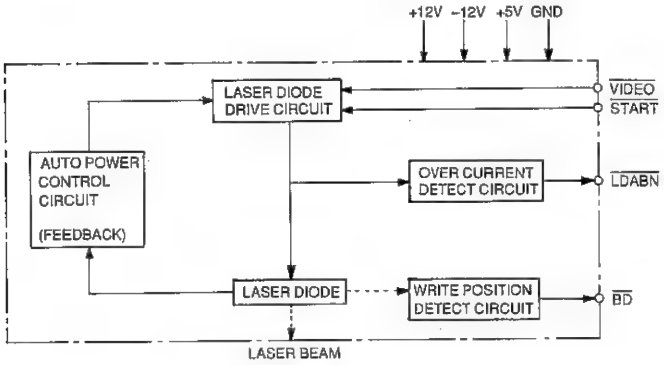


Fig. 15

The LDD PWB has the following functions:

(1) Beam emit power of the laser diode is maintained at the given level constant at all times.

(2) $\overline{\text{BD}}$ is issued.

The signal $\overline{\text{BD}}$ is issued when laser beam is detected, to determine the write start position.

(3) Laser diode beam emit is controlled on and off with the $\overline{\text{VIDEO}}$ signal.

(4) Irregular state of laser diode is detected by overcurrent.

When overcurrent occurred, $\overline{\text{LDABN}}$ is forced low.

3-2-2. Polygonal motor drive PWB (PMD PWB)

When the motor speed reaches the rated 6496.06 revolutions per-minute the signal; $\overline{\text{PMTLK}}$ is issued. On and off of the motor is controlled with $\overline{\text{PMD}}$.

Polygonal motor drive circuit block diagram

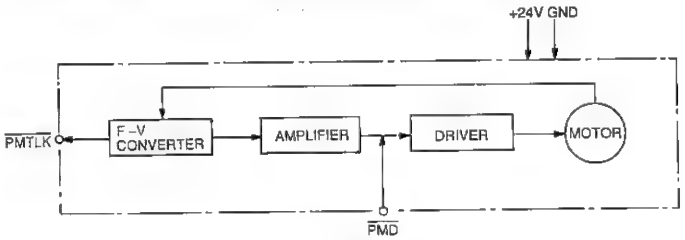


Fig. 16

3-3. Print control circuit

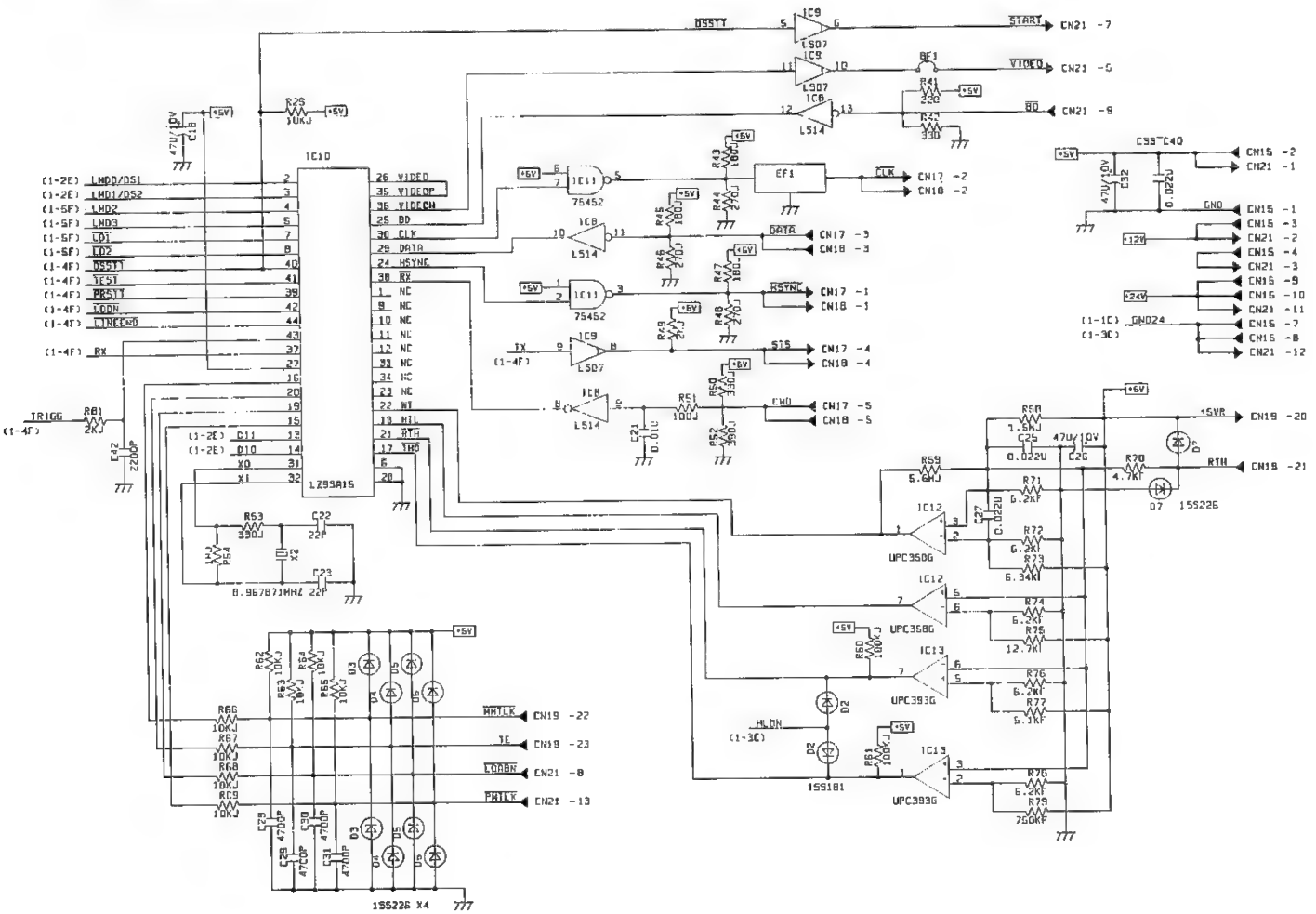


Fig. 17

(Signal description)

$\overline{\text{READY}}$:	Print engine ready
$\overline{\text{PAGE}}$:	Start printing (This signal is issued from the ICU for every page and stays at a low level for the page.)
$\overline{\text{OSSTT}}$:	Start the optical system. Used for the start signal on the print control circuit
$\overline{\text{START}}$:	Start the LSU (laser scan unit).
VIDEO:	Laser diode modulation signal, active high. This is the signal which the data sent from the ICU is sampled by the PCU internal clock and is used to activate the laser diode immediately before the beam detector.
VIDEON:	VIDEO inverted signal.
$\overline{\text{BD}}$:	Laser beam detect signal.
$\overline{\text{LINEEND}}$:	Print data becomes valid when this signal is at a high level. From the high to low transition of this signal to low to high transition of -BD, the laser diode is active. Also, an interrupt is applied to the HD63A01Y0P at the start of this signal.
TRIGG:	$\overline{\text{LINEEND}}$ is forced from high to low at the start of this signal.
$\overline{\text{PRSTT}}$:	Print start. When this signal is at a low, $\overline{\text{CLK}}$ and $\overline{\text{HSYNC}}$ are issued to the ICU.
$\overline{\text{CLK}}$:	Sync clock used to send the print data. The ICU changes the print data at a high to low transition of this signal.
$\overline{\text{HSYNC}}$:	Horizontal sync signal for printing.
$\overline{\text{DATA}}$:	Print data synchronized with $\overline{\text{CLK}}$.
$\overline{\text{TEST}}$:	Print test data in the diagnostic mode.
$\overline{\text{LDON}}$:	Laser diode activating signal. Used to force the laser diode to emit beam. When this signal is turned low while $\overline{\text{OSSTT}}$ is low, the laser diode is activated.
LMD0 to LMD3:	Left margin data. 4-bit information to set the left margin.
$\overline{\text{LD1}}$ to $\overline{\text{LD2}}$:	Used to load LMD0 to LMD3 in the counter.

The print control circuit consists of the following circuits.

CPU (HD63A01Y0P, IC7)

Gate array (LZ93A15, IC10)

Signal buffer (IC8, IC9, 9C11)

3-3-1. Gate array (LZ93A15)

The gate array (LZ93A15) incorporates a data selector (74153Z) in addition to the print control circuit.

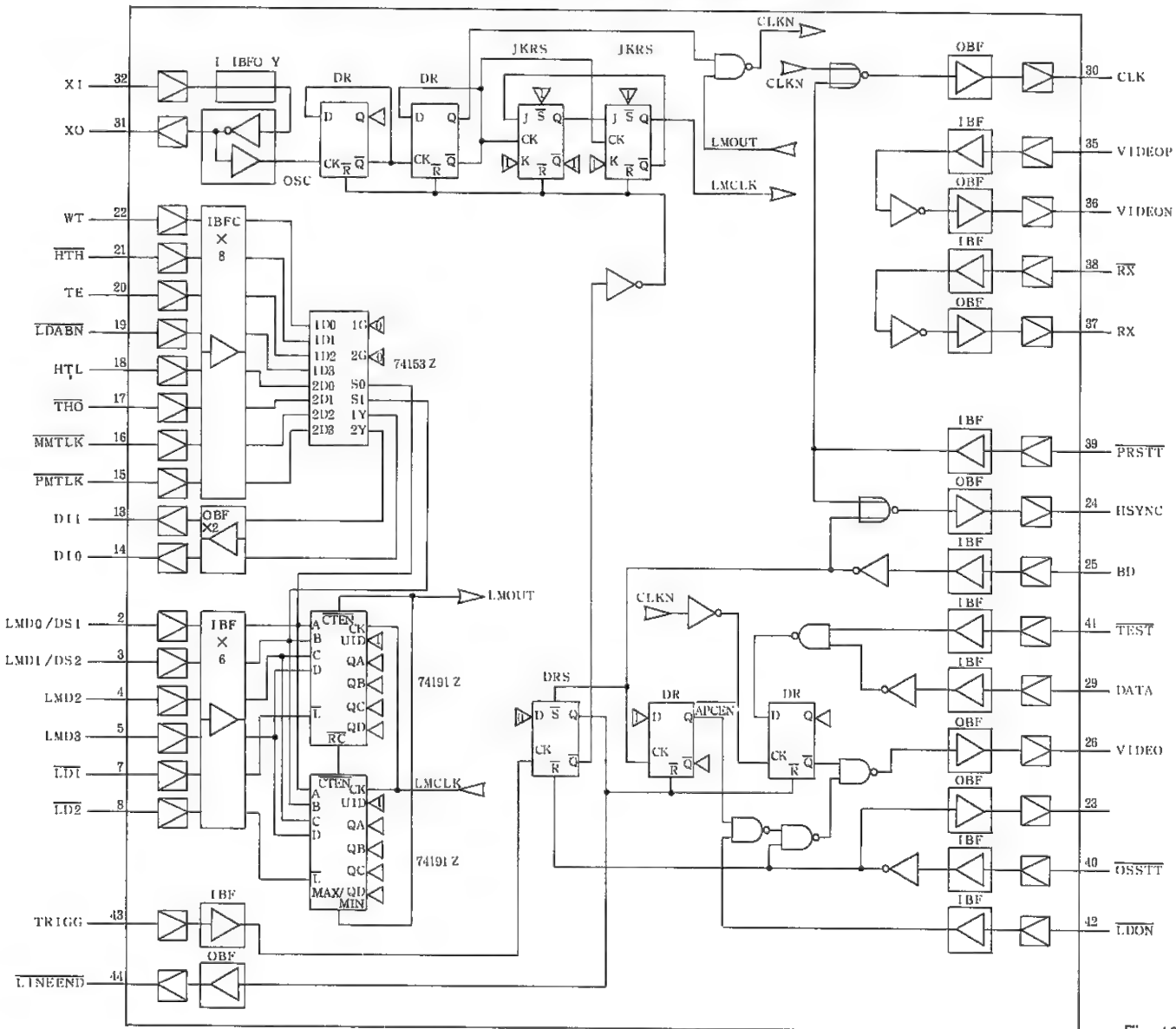


Fig. 18

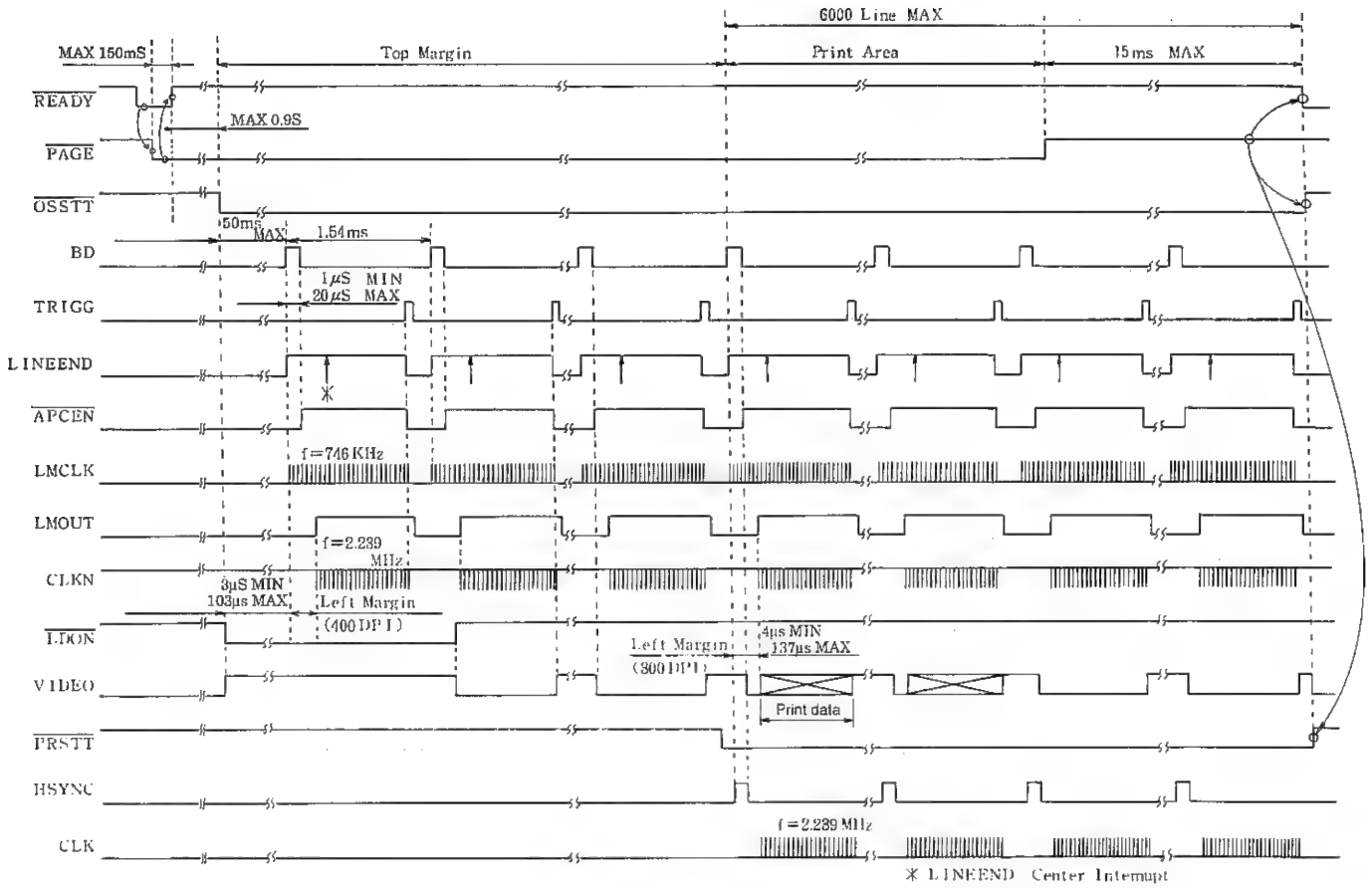


Fig. 19

Fig. 19 shows the timing of the print control circuit. Action takes place in the following order.

(1) After confirming that READY is at a low, the ICU sets PAGE low.

(2) When the PCU detects a low state of PAGE, READY is set high and OSSTT low, to set the print control circuit active. At the same time, LDON is forced low to activate the laser diode to be ready for an incoming BD signal.

(3) When BD goes high, the DRS flip-flop is set active at the start of the signal and LINEEND is forced high.

(4) At a low to high transition of LINEEND, an interrupt (BD interrupt) is caused to the CPU to execute the following.

a. The CPU internal timer is set to be ready to issue a next interrupt (lineend center interrupt).

b. After OSSTT is set low, interrogation is made to see if it is the second interrupt. If so, LDON is forced high.

(5) When LINEEND goes high, LMCLK is supplied to the CK input of the 74191Z counter to start counting the left margin information (LMD0 to LMD3) given by the CPU. (For the resolution information of 400dpi had been primarily set, a new margin information is set after the resolution of the LSU is determined. Therefore, the left margin information may differ for the one given for printing until the left margin is determined. The resolution is interrogated and determined within 204ms after OSSTT changed from high to low, and 300dpi is established in the case of this printer.) When the 74191X counter finishes counting, LMOUT is set high and CLKN is issued.

(6) A lineend center interrupt occurs according to the time given by the timer set by the BD interrupt. With this interrupt, the following process takes place by the CPU program.

a. Sets the CPU internal timer to be ready to issue a next interrupt (lineend interrupt).

b. The value in the line counter (soft counter) is incremented.

c. The PSS (paper stop solenoid) is set active according to the value in the line counter.

(7) A lineend interrupt is caused in the period given by the timer set by the lineend center interrupt and, at the same time, TRIGG is set high. LINEEND is forced low because of TRIGG, and APCEN stayed high by the falling edge of BD is also set low. As LINEEND goes low, LMCLK and CLKN outputs are stopped. With a low state of APCEN the laser diode comes active immediately before the beam detector.

The lineend interrupt executes the following by the CPU program.

a. Timer is set active to turn TRIGG low.

b. Left margin information LMD0 to LMD3 are loaded in the 74191Z.

c. PRSTT or TEST is selected according to the value in the line counter.

d. OSSTT is set high according to the condition.

(8) The above steps (3) thru (7) are repeated until the top margin is established. The top margin is formed by adjusting the timing using the line counter that PRSTT is set low at timing when PSS is turned on.

(9) When PRSTT is forced low by a lineend interrupt, BD and CLKN are issued to the ICU as HSYNC and CLK signals.

(10) The left margin is set according to (3) and (5) and CLK is sent to the ICU according to the timing appropriate to the left margin. The print data is sent out as DATA from the ICU in sync with CLK and VIDEO is modulated with DATA.

(11) The above actions (3) thru (10) except for (8) are repeated for a maximum 6000 lines until single page printing is completed.

(12) When printing is complete for a page, OSSTT is set high to reset the print control circuit, and PRSTT is set high and READY low.

3-3-2. ICU-PCU interface

Data transfer between the ICU and the CPU takes place via the video interface. The ICU sends DATA to the PCU in sync with CLK received from the PCU.

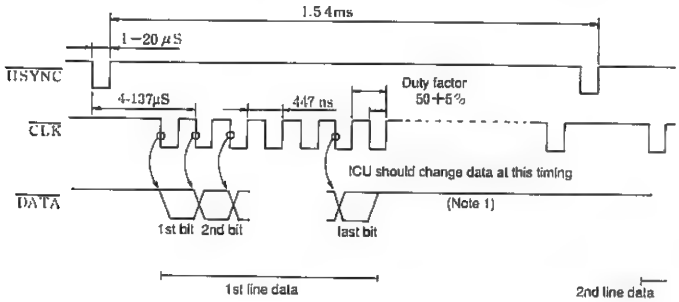


Fig. 20

NOTES: 1. $\overline{DATA}$ needs to be at a high level (white) after sending the last bit of a line.

2. $\overline{DATA}$ is issued at a high to low transition of $\overline{CLK}$ and samples at a next falling edge.

4. Operation unit control circuit

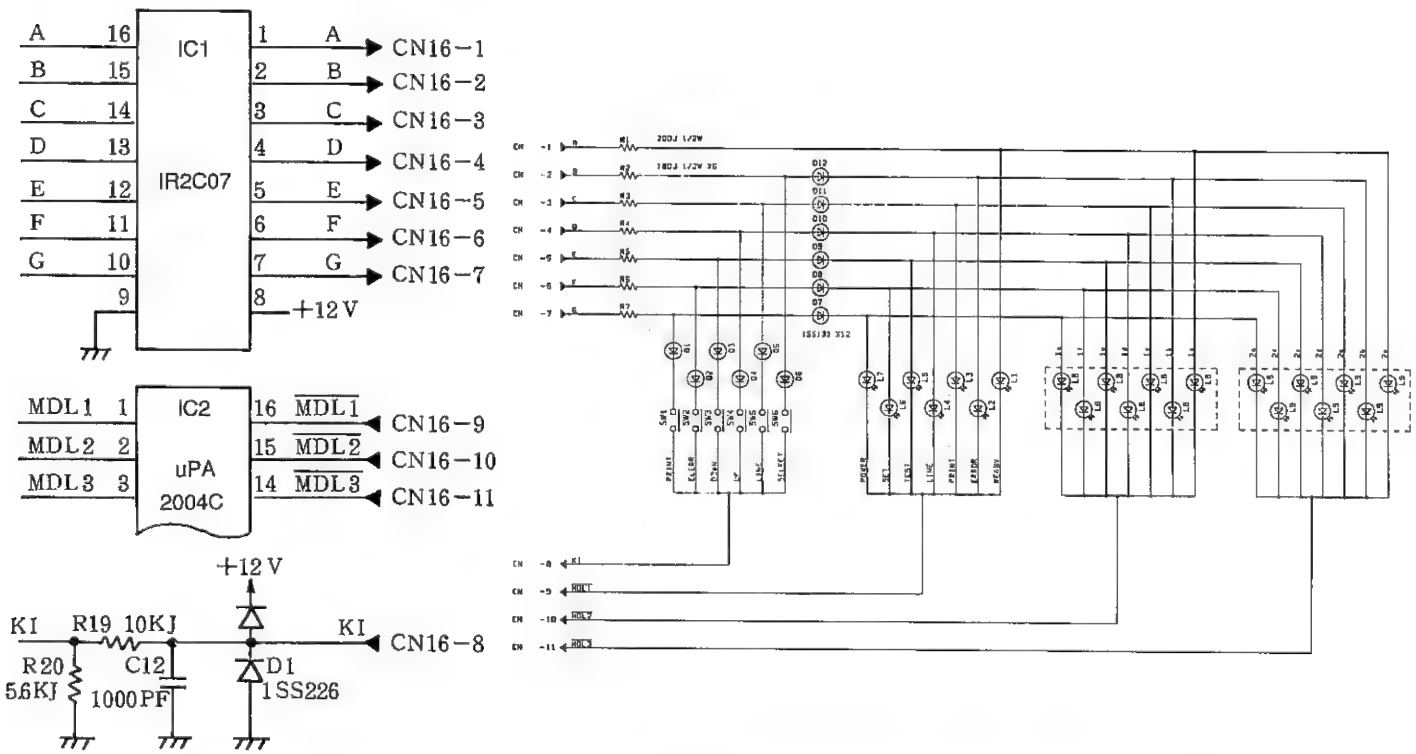


Fig. 21

The display and keyboard operations of the OPU is controlled by a 1ms timer interrupt from the CPU.

Display operation is controlled in the following three blocks.

(1) LED (L1 ~ I7)

(2) 7-segment display-1 (high order digits)

(3) 7-segment display-2 (low order digits)

Keyboard entry is controlled by one block.

See Table 9 for the keyboard and display control matrix.

Table 9 Key & Display Matrix

	MDL1	MDL2	MDL3	KI
A	READY	1a	2a	*
B	ERROR	1b	2b	SELECT
C	PRINT	1c	2c	LINE
D	LINE	1d	2d	Δ
E	TEST	1e	2e	∇
F	SET	1f	2f	CLEAR
G	POWER	1g	1g	PRINT

* not defined

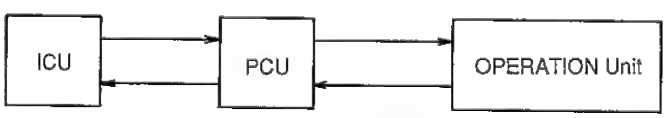


Fig. 22 Normal Operation

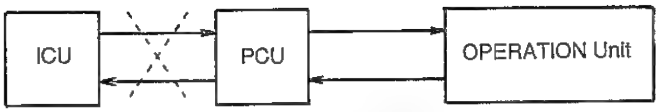


Fig. 23 PCU Diagnosis

4-1. Operation unit control

(1) Normal operation (Fig.22)

The CPU operates the LED and the 7-segment displays according to control code (CMD) received from the ICU, regardless of the PCU internal state. The PCU informs the ICU the state of key entry.

(2) PCU diagnosis (Fig.23)

After the CPU went into the diagnostic mode, response is given only to the SSA control code (status sense A).

4-2. OPC drive timing

Table 9 shows the keyboard and display control matrix.

Fig.24 shows the OPU drive timings.

Key input operations are performed in two blocks of key 1 and key 2.

Key 1: SELECT, LINE, Δ

Key 2: ∇, CLEAR, PRINT

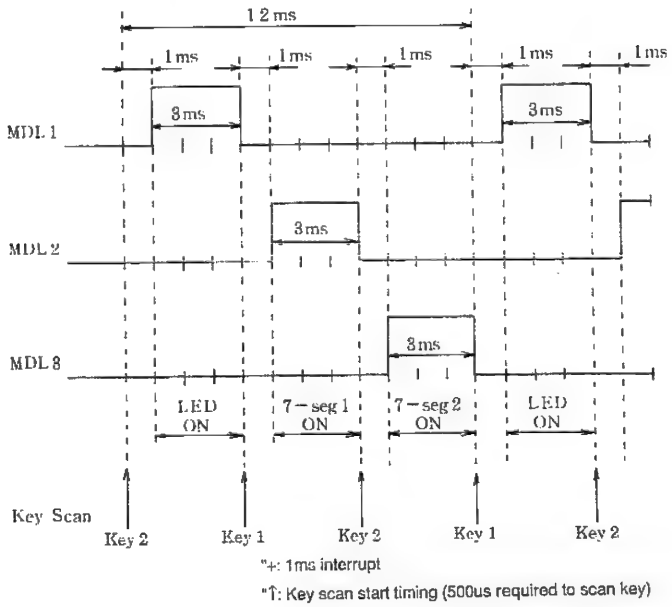


Fig. 24

5. Print process control circuit

The print process control circuit controls the printer engine, except for the LSU and the OPU, and it consists of the following:

(1) Engine status input circuit

(2) Heater lamp control circuit

(3) Toner motor driver

(4) High voltage unit, main motor, fan motor, solenoid control driver

5-1. Engine status input circuit

Used to monitor status of the printer engine and a data selector is used to accept a signal to save the CPU from input and output accessing.

The LS153 of IC5 and the 74153Z inside the gate array IC10 are employed for the data selector.

Legend:

PIN:	High when there is a paper over the paper entry sensor.
HFIN:	High when there is a paper over the manual bypass sensor.
FDOUT:	High when there is a paper over the face down stacker paper exit sensor.
POUT:	High when there is a paper over the paper exit sensor.
CMIS:	High when the toner cartridge is not installed.
$\overline{\text{FDOWN}}$:	Low when in the face down paper exit mode.
MM24:	Low when the face down stacker is open or the front door is open. At 24V when both are closed.
WT:	High when the heater lamp temperature is above 165°C.
HTL:	High when the heater lamp temperature is above 100°C.
$\overline{\text{HTH}}$:	Low when the heater lamp temperature went above 240°C.
$\overline{\text{THO}}$:	Low when the heater lamp thermistor is open.
$\overline{\text{MMTLK}}$:	Low when the main motor is running under the PLL sync revolutions.
TE:	High when undertoner is detected in the developer cartridge.
$\overline{\text{LDABN}}$:	Low when the laser diode is controlled abnormal.
$\overline{\text{PMTLK}}$:	Low when the polygonal motor is running under the PLL sync revolutions.
DI0–DI3:	Data selector outputs
LMD0/DS1: LMD1/DS2	Data selector signal, DS1, DS2 used common with left margin data LMD0, LMD1.

Table 9 shows the data selector signal matrix.

DS1	DS2	DI0	DI1	DI2	DI3
0	0	WT	HTL	PIN	POUT
1	0	$\overline{\text{HTH}}$	$\overline{\text{THO}}$	HFIN	CMIS
0	1	TE	$\overline{\text{MMTLK}}$	FDOUT	$\overline{\text{FDOWN}}$
1	1	$\overline{\text{LDABN}}$	$\overline{\text{PMTLK}}$	*	MM24

* not defined

5-2. Heater lamp control circuit

This circuit is employed to control heater lamp activation and to detect error by converting the thermistor resistance into voltage and comparing it with four kinds of reference voltages.

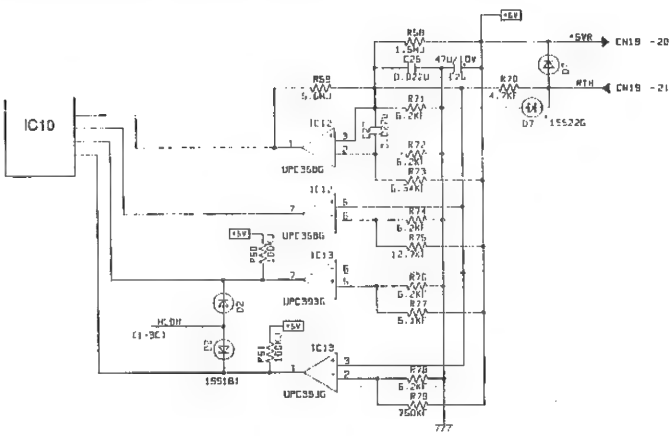


Fig. 27

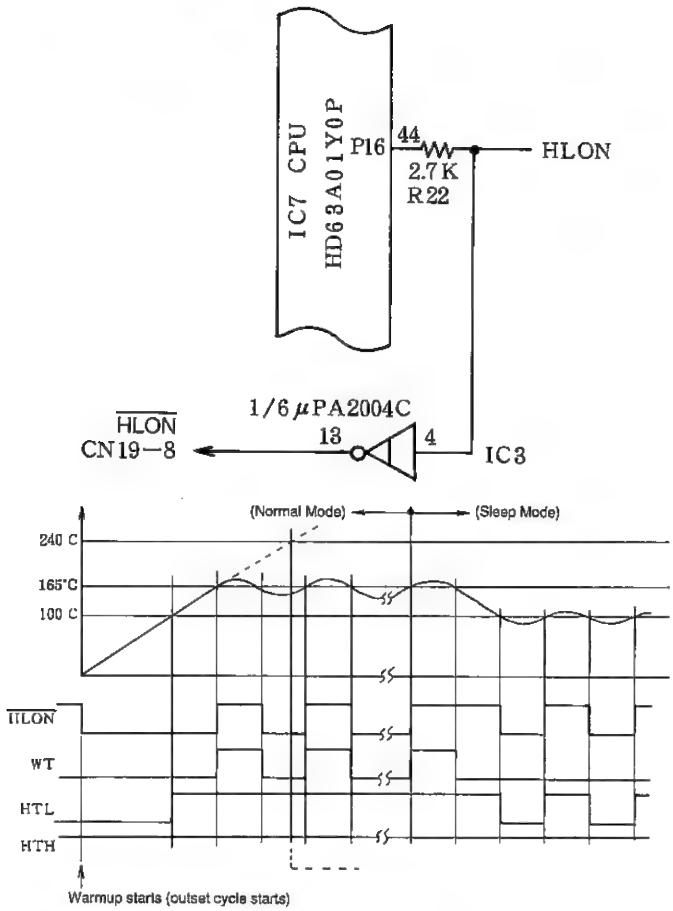


Fig. 28

(Operational description)

a. When warmup starts, the CPU sets HLON high to activate the heater lamp.

b. When the heater temperature reaches 100°C, HTL is forced high and WT is also forced high at above 165°C.

c. When WT turns high, the CPU sets HLON low to turn off the heater lamp.

d. When WT goes low after the heater lamp dropped below 165°C, the CPU sets HLON high to activate the heater lamp.

e. As the above steps "c." and "d." are repeated, the heater lamp temperature is maintained to the constant level.

f. If $\overline{\text{PAGE}}$ were not issued from the ICU within four minute after the printer became ready, the printer then goes into the sleep mode. In the sleep mode, the heater lamp temperature is controlled to change from 165°C to 100°C. The same steps "c." and "d." are carried out except HTL is referred to. When "non-sleep mode" is selected by user diag No. 6, the printer will not go into the sleep mode.

(Engine signal)

a. Open thermistor

$\overline{\text{THO}}$ is forced low when a failure is in the thermistor.

b. High temperature fault

$\overline{\text{HTH}}$ is set high when the heater lamp temperature goes above 240°C.

When one of the above two faults are met, HLON is clamped low by the diode D2 and the heater lamp is forced off.

5-3. Toner motor drive

Concentration of the toner within the developer cartridge is checked by means of the TE signal from the toner sensor for controlling toner motor activation.

As a synchronous motor is used for the toner motor, it is necessary to switch the coil current direction by synchronizing frequency to rotate the toner motor. For this purpose, the TA7291S(VFS) bridge driver is employed as a motor driver.

Block diagram

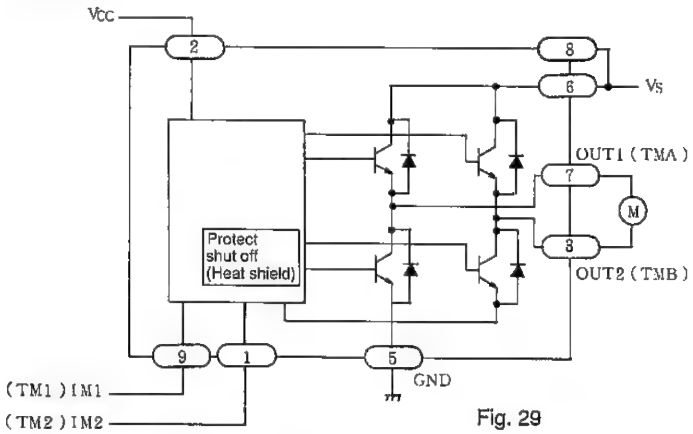


Fig. 29

INPUT		OUTPUT		MODE
IN1	IN2	OUT1	OUT2	
0	0	∞	∞	Stop
1	0	H	L	CW/CCW
0	1	L	H	CCW/CW
1	1	L	L	Brake

∞: High impedance Active high input

Features:

(a) Full bridge driver that controls four modes of forward, reverse, stop, and brake.

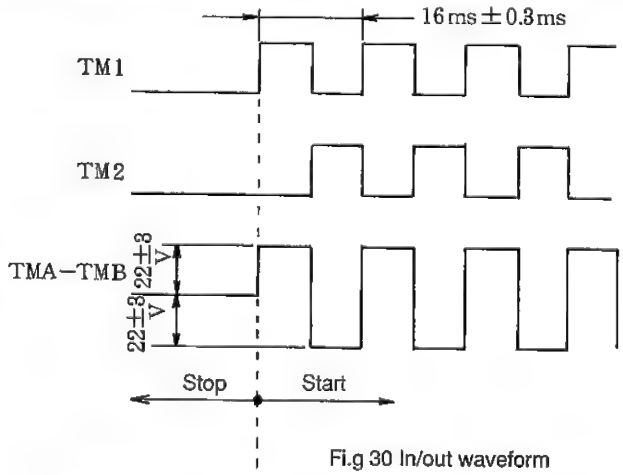
(b) Internal heat shut off circuit and output line protect circuit

(c) Internal input hysteresis circuit

(d) Internal standby circuit

(e) Internal counter-electromotive force killer diode

The toner motor can be controlled to start and stop by giving the signal from the CPU as shown in Fig.30 as TM1 and TM2. Revolutions of the toner motor shaft is 4rpm.



Fi.g 30 In/out waveform

5-4. MM24

The signal MM24 is used to sense the state of the face down stacker and front door. +24V is sent when they both are closed, and GND is sent when either is open (see Fig.31).

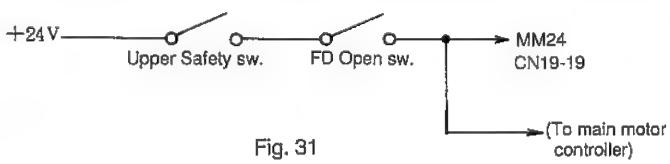


Fig. 31

6. High voltage unit (HVU)

Consists of the MC circuit, TC circuit, bias circuit, and grid circuit; each one having the following assignment.

MC circuit: High voltage is added to the main corona unit to charge the drum surface.

TC circuit: High voltage is added to the transfer corona unit to transfer the toner on the drum surface to the copy paper.

Bias circuit: Charges carrier within the developer cartridge.

Grid circuit: Used to stabilize the potential on the drum surface by controlling the scorotron charge device.

A screen grid is provided between the main corona wire and the photoconductor, and the constant voltage is added to the grid to distribute the corona current to the photoconductor and the grid. As the surface potential of the photoconductor increases by corona charge, the current flowing through the grid increases. As the photoconductor potential reaches the grid potential, the entire current flows to the grid so that the photoconductor potential is maintained at the given level at all times.

(Interface with PCU)

Control signal	
$\overline{\text{MHVON}}$ / $\overline{\text{THVON}}$	Output is active when the control signal is below 2V.
	Output is not active when the control signal is open.
BIASON	Output is active when the control signal is open.
	Output is not active when the control signal is below 2V.
$\overline{\text{GRLON}}$	Output is high (–520V) when the control signal is open.
	Output is low (–350V) when the control signal is below 2V.

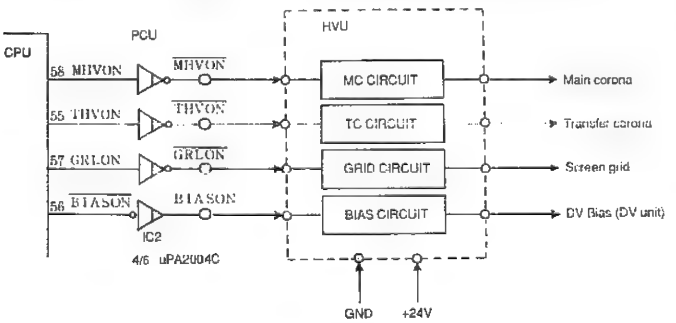


Fig. 32

7. Main motor controller

Used to control start and stop of the main motor with $\overline{\text{MMD}}$ from the PCU and to maintain the motor revolutions as determined.

For the main motor is procured from two manufacturers, there are two types of main motor controllers.

Manufacturer's Number ..... Manufacturer

TL0403 ..... KOKUSAN DENSKI

GLQ-6DA027S ..... MATSUSHITA MICROMOTOR

MAIN MOTOR CONTROL CIRCUIT

BLOCK DIAGRAM

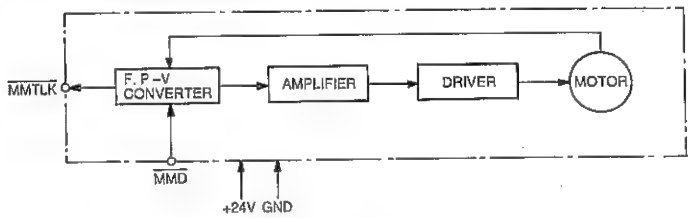


Fig. 33

$\overline{\text{MMD}}$: The motor starts to run when $\overline{\text{MMD}}$ is set low.

$\overline{\text{MMTLK}}$: When the motor revolutions go out of the speed setting (±5%), the output signal is set high to inform of an abnormal condition.

(PCU and its interface)

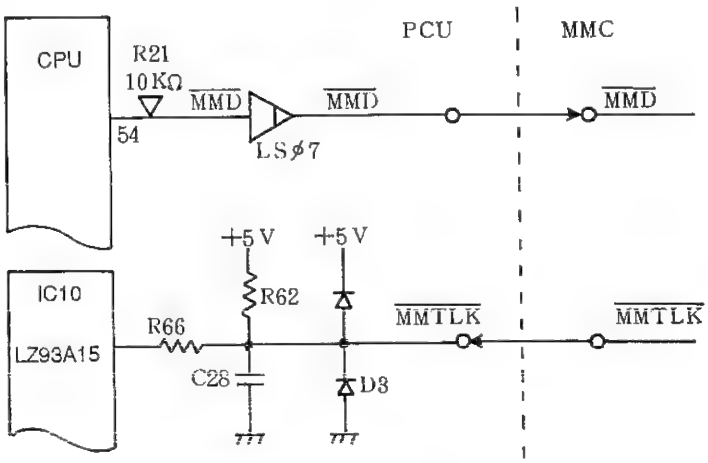


Fig. 34

8. Fan motor control

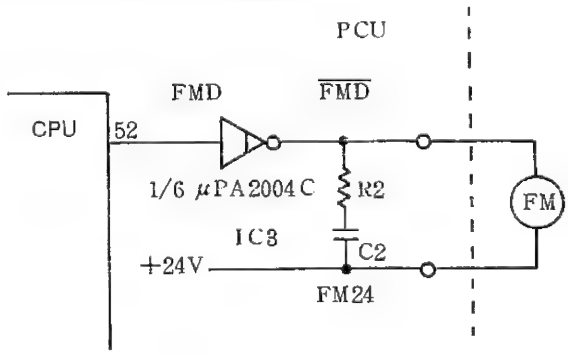


Fig. 35

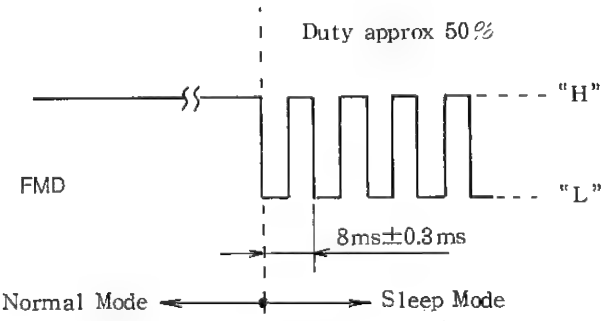


Fig. 36

There are two modes to run the fan motor; one is the normal mode in which case the CPU keeps FMD high at all times to continuously supply power to the fan motor and the other is the sleep mode in which case FMD is sent in 50% duty to cut power supply one half of the normal mode if $\overline{\text{PAGE}}$ were not received within four minutes after the printer became ready.

9. Print sequence control

The CPU controls the sequence of the print engine based on the information from the ICU and the print engine.

9-1. Outset timing

Prior to starting the image forming process, the outset cycle is used to initially reset the drum.

A different method is applied depending on how the preceding process ended; normal or abnormal termination.

Abnormal termination applies to the following cases:

(Abnormal termination)

(1) Occurrence of an error other than CC, PC, DL, OH, and PO (see the error code chart).

(2) When power is shut off in the middle of the print cycle.

The outset cycle will start at one of the following:

(1) At power on (not executed when going into the PCU diag mode).

(2) When recovered from an error state (CLEAR key depressed).

(3) When returning from the sleep mode to the normal mode (by means of $\overline{\text{PAGE}}$ signal).

9-1-1. After normal termination

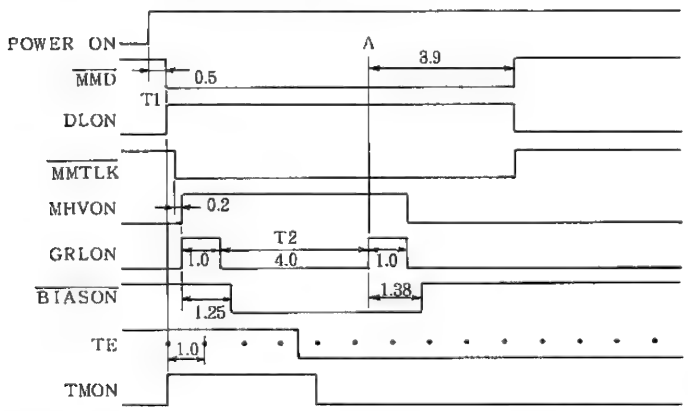


Fig.37 Outset process timing after normal termination (unit: second)

NOTE: Dot: TE sampling point

TMON: Toner motor on

Figure 37 shows the timings of the outset process for normal termination at power on.

(1) When the power is turned on, the main motor and the discharge lamp go active in 0.5 second after the CPU was initially reset.

(2) When $\overline{\text{MMTLK}}$ is set low after the main motor reached the predetermined sync speed, the main corona comes active in 0.2 seconds later. This 0.2 second delay is needed for added time of DL light quantity and stabilizing time for the sensitive drum revolution and to prevent an irregular rise in the drum surface potential caused by the main corona output.

(3) GRLON and $\overline{\text{BIASON}}$ are issued following MHVON. The timing those changes are related to the developing mode, which will be discussed below.

With the JX-9300, print pattern signal is written by the semiconductor laser beam to form a visible image on the drum surface using the positive image method (reversal).

If the developing bias is added before the drum is charged, toner is attracted on the drum surface. If developing bias was not added while the drum is charged, the carrier will be attracted onto the drum because of the strong attraction of the drum.

To avoid those problems, the potential in the drum surface is controlled by switching on the grid voltage and the developing bias at the appropriate timing.

(Basic operation)

Voltage added to the screen grid is changed high and low using GRLON. With a high state of GRLON, the main corona output is low and vice versa.

Figure below shows transition of voltages at the developing unit to permit easier understanding. Because the location of the main corona differs from the location of the developing unit, it may not look the same as the timing charge in Fig.37.

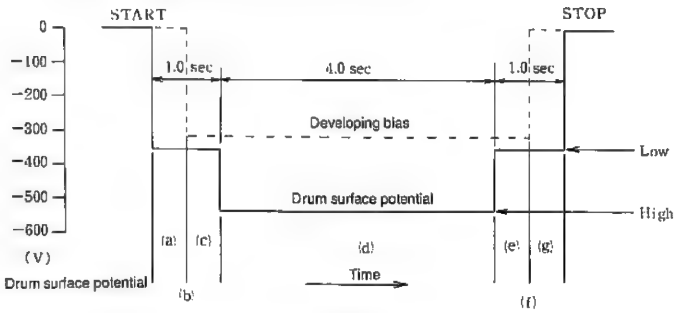


Fig. 38

(a) The grid voltage is at a low level, the drum surface potential is at about -350V. Though the carrier is attracted to the drum by −350V, no carrier is deposited.

(b) Developing bias of -320V is added when the drum surface potential is at a low level.

(c) No toner is attracted even if the developing bias of -320V is added, the difference with the drum surface potential (-350V) is about 30V.

(d) After the developing bias is added, the grid voltage goes high and the drum surface potential becomes -520V. However, no carrier or toner deposit occur. This condition continues for 4 seconds (T2), during which time the drum makes one half a rotation to initialize the drum surface.

(e),(f),(g) Reverse sequence of (a) to (c) which the developing bias and the main corona output discontinue.

(4) It goes into the outset termination cycle from point A (Fig.46), and in 3.9 seconds, the main motor and the discharge lamp turn off.

The above described the outset timing at power on.

For transition from the sleep mode to the normal mode and from CC, PC, DL, OH, and PO error, all signal timings are the same as discussed, except that a high to low transition of $\overline{\text{MDD}}$ is different immediately after the transition was made.

9-1-2. After abnormal termination

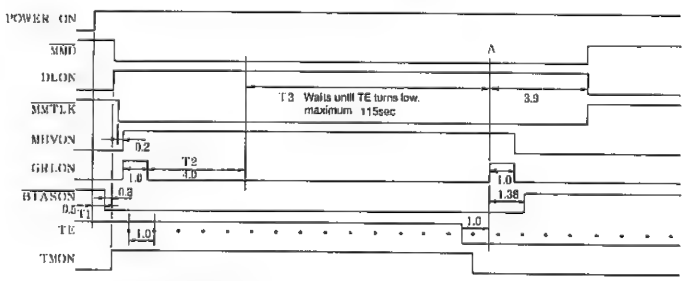


Fig. 39 Outset cycle timing after abnormal termination (unit: second)

NOTES: Dot: TE sampling point

TMON: Toner motor on

Figure 39 shows the timing for the outset cycle after abnormal termination during power on.

What the outset cycle timing after abnormal termination differs from that of the normal termination is the timing that the developing bias is at start up.

(What is shown in Fig.39 differs in its longer outset cycle by T3 as compared with that of Fig.37. Explanation will be given to this point.)

When an abnormal termination occurred in the middle of a print cycle, the potential in the drum surface reduces towards dark while the drum surface potential was at a high level (-520V). If the drum is rotated without adding the developing bias before the drum has been completely reduced, carrier-drop occurs. To prevent this, the developing bias adds 0.3 second before the start of the main motor to attract the carrier to the developer side.

Fig.39 shows the outset timing during power on. In the case of returning from an error other than CC, PC, DL, OH, and PO, the rest of the signals timing are the same except that the transition of $\overline{\text{BIASON}}$ to a low state takes place immediately after the return.

9-1-3. TE signal detection

When the outset cycle starts after the completion of the T1 cycle, the CPU begins to look for the TE signal. If TE was low continuously for more than 1.0 second before the end of the T2 cycle the machine will go into the outset cycle termination. (The outset cycle is the shortest in Fig. 37). If TE was not low continuously for more than 1.0 second before the end of the T2 cycle, it will go into the T3 cycle. This cycle is extended until a continuous low state of TE for 1.0 second is made. After a maximum of 115 seconds, the machine will then go into the outset mode termination cycle (Fig.39).

9-2. Print cycle timing

When the PAGE signal is issued from the ICU with the print engine in the ready state, the print engine goes into the print cycle.

The print ready state is established when the following conditions are met.

(1) The outset cycle must have been completed.

(2) Warmup must be have been completed. Warmup will be complete at the moment the heater lamp temperature reached 165°C after the start of the outset cycle.

(3) No error was met.

9-2-1. Single page print

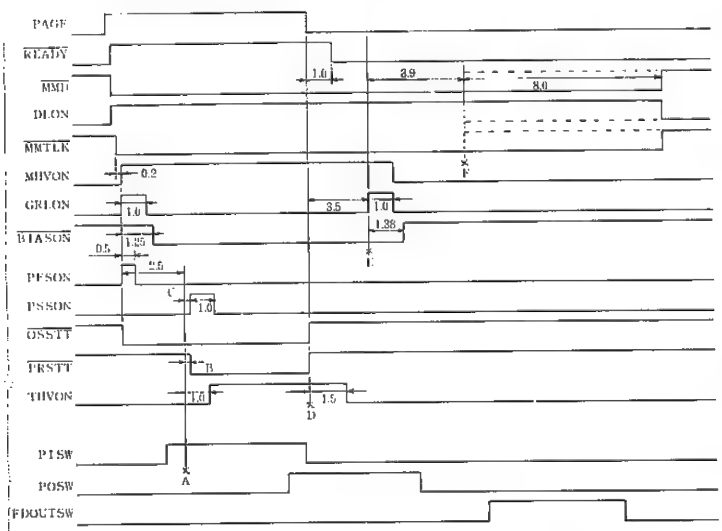


Fig. 40 Print cycle timing (single print)

(unit: second)

NOTES:
- Paper detect sensors (PISW, POSW, FDOUTSW) are provided assuming the use of 8-1/2" x 11" paper.
- PO error is judged at point A.
- Point D is the reference point of print cycle end.
- The print cycle terminates at point D.
- In the case of the face up mode, the print cycle will terminate at point F.

Figure shows the print cycle timing in the single print mode.

(1) The ICU sends the PAGE signal to the PCU after confirming that $\overline{\text{READY}}$ is at a low level.

(2) When the PCU microprocessor recognizes a high state of PAGE, $\overline{\text{READY}}$ is set high to go into the print cycle.

(3) In the print cycle, the main motor and the discharge lamp are activated, then the following actions will take place.

(a) The main corona and the developing bias will activate. MHVON, GRLON, and $\overline{\text{BIASON}}$ signal on and off timings are the same as those of the outset cycle.

(b) As PFS is issued, a paper is fed into the machine.

(c) $\overline{\text{OSSTT}}$ is set low to start the print control circuit and the LSU. The PCU checks the resolution of the LSU within MAX 250ms after $\overline{\text{OSSTT}}$ is turned low level.

(4) In 2.5 seconds after PFS was issued, the CPU goes to check if PISW paper detect sensor has turned on. If not the PO error is established.

(5) In 2.5 seconds after $\overline{\text{OSSTT}}$ was set low, the CPU starts counting the number of lines (number of laser beam scans). The leading edge margin of the paper is established by adjusting the activating timing of PSSON and $\overline{\text{PRSTT}}$ based on this line count value. (B and C in Fig.49). Described next is the line count value in regard to B and C.

Lead edge adjust value "N" (where, N = 0 to 99, to be programmed by the diag No.10.)

B = 44 + 3N (count)

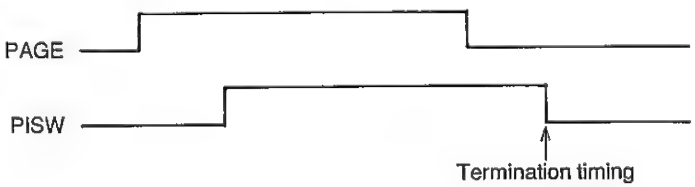
C = 74 (count)

If "N" is incremented by "1", the lead edge margin increases 1/100".

(6) Just before the print paper reaches the transfer point, the transfer corona comes on (in 3.5 seconds after PFS turned on).

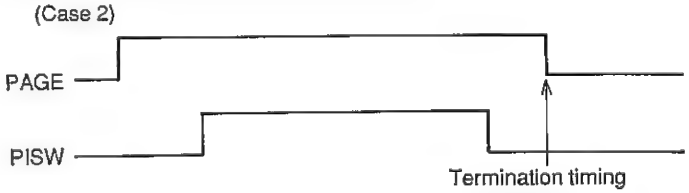
(7) The machine goes into the print termination cycle in one of the following three cases:

(Case 1)



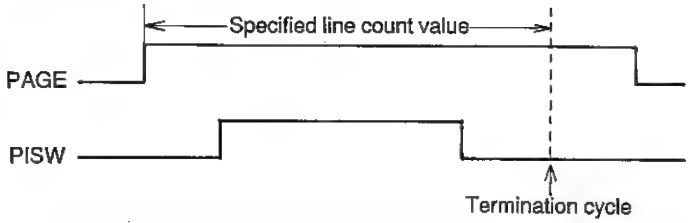
In the above case, where PAGE is driven low before PISW is turned off, the print termination cycle is started.

(Case 2)



In the above case, where the discount value is within the specified range (Note 1) and PISW is turned off before PAGE is driven low, the print termination cycle is started when PAGE is driven low.

(Case 3)



In the above case, where PAGE is high and the line count value exceeds the specified range (Note 1), the print termination cycle is started when the line count value reaches the specified value.

(Note 1) The specified line count, value depending on the lead edge adjustment, is approx. 6000.

(8) When the print cycle goes into the termination cycle, $\overline{\text{OSSTT}}$ and $\overline{\text{PRSTT}}$ are forced high. In 1.0 second later, $\overline{\text{READY}}$ is set low. In 1.5 seconds later, the transfer corona turns off. In 3.5 secs later (point E in Fig. 40), the main corona, developping bias, and the main motor turns off in this sequence. It is similar as the outset termination process from point E through point F.

(9) If paper is released in the face up mode, the main motor and the discharge lamp are set off at point F (Fig.40) and the print cycle terminates. In the case of the face down mode, after 8.0 seconds from point F, the main motor and the discharge lamp set off to terminate the print cycle.

9-2-2. Multipage print

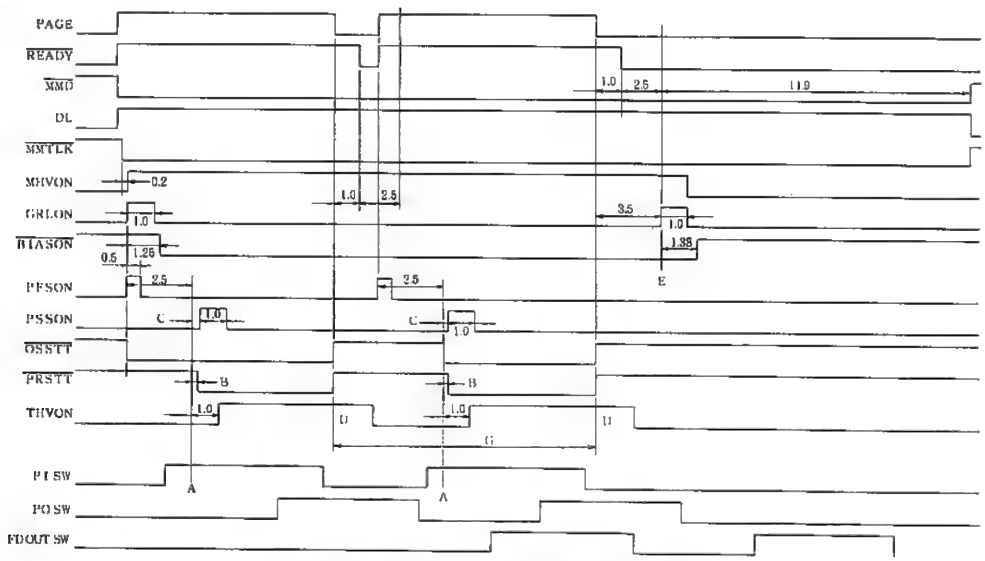


Fig. 41 Print cycle timing (multipage print)

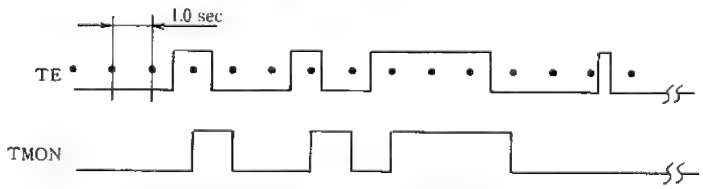
NOTES:
- The paper detect sensors (PISW, POSW, FDOUTSW) are provided considering the 8-1/2" x 11" page to print.
- The face down mode is considered for the paper delivery mode.
- PO error is judged at point A.
- The lead edge margin is adjusted at the timing B and C.
- Point D is the base for the print cycle termination.

Fig.41 shows the print cycle timings in the multipage mode (printing two pages).

As known from the comparison with the single page mode, the cycle G (Fig.41) is added. In Fig.41, two pages are assumed for the number of pages to print, and only the cycle G is added according to the number of pages increased.

When the point D (Fig.41) is reached, the CPU awaits for PAGE to appear for a period of 1.0 to 3.5 seconds. When PAGE is detected in that period, PFS is issued at the moment PAGE is detected to start sending a next paper. In this case, the main corona and developing bias are supplied in continuation to perform a series of print cycles. Meanwhile, if PAGE was not detected, the print cycle terminates.

9-3. Toner motor control



NOTES: Dot: TE signal sampling point

TMON: Toner motor on

Fig. 42 Toner motor control (print cycle)

In the outset cycle and the print cycle, the CPU samples TE at every 1.0 second while the main motor is in rotation. When TE is at a high, the toner motor is turned on. If low, the toner motor is turned off.

9-4.Print cycle termination at an error

If one of the following errors was encountered during the print cycle, signals are set off except for $\overline{\text{BIASON}}$ at this point (Fig.43).

Error Code: PJ, d0, C1~C6, P4

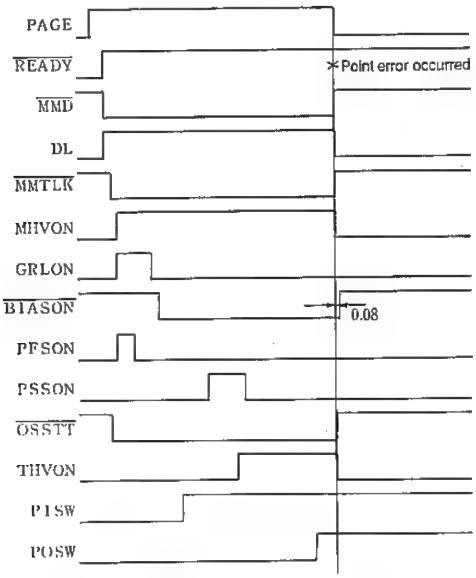


Fig. 43 When an error is met

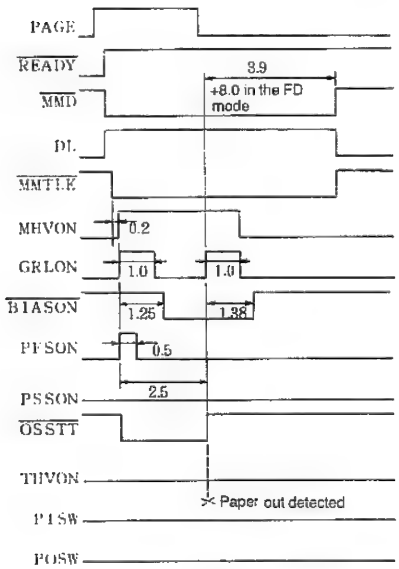


Fig. 44 When POUT issued

In this case, the drum potential is high (about -520V) immediately after MVON is set off. If $\overline{\text{BIASON}}$ is set off at the same time as MHVON, carrier may fall as the drum rotates. So, only the $\overline{\text{BIASON}}$ signal is kept on by the CPU until the drum comes to a complete stop (0.08 seconds after MMD is set high).

When power is turned off duing a print cycle, carrier fall may be caused for the same reason as above. It is not possible for the CPU to retain $\overline{\text{BIASON}}$, the developing bias voltage is retained by the high voltage unit.

When a PO error has occurred (Fig.44), the normal termination cycle takes place after the error occurrence, different from the above error.

9-5. Sleep mode

If $\overline{\text{PAGE}}$ was not received from the ICU within four minutes after the printer became ready, the print engine goes into the sleep mode. Note that the sleep mode is not available in the diagnostic mode and that if the non-sleep mode is chosen by the user diag No.6, it does not go into the sleep mode.

In the sleep mode, there are the following two differences as compared with the normal mode (printer at ready state).

(1) The heater lamp control temperature is changed to set 100°C from 165°C.

(2) The fan motor rotation is changed from the normal mode to the slow mode (pulse driven).

It returns from the sleep mode to the normal mode with $\overline{\text{PAGE}}$ sent from the CPU.

9-6. Error detect specification

Discussion will be given below for error interrogation in regard to the print engine (other than ICU).

(1) PJ (paper jam)

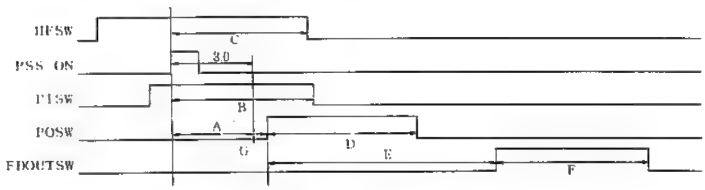


Fig. 45 Misfeed interrogation

(NOTE) HFSW: Hand Feed sw
PISW: Paper In sw
POSW: Paper Out sw
FDOUTSW: Face Down Stacker Out sw

(Criterion)
See Fig. 45.

1. The POSW does not turn on (A) within 5 seconds after PSS turned on.
2. The PISW does not turn off (B) within 8 seconds after PSS turned on.
3. The HFSW does not turn off (C) within 8 seconds after PSS turned on.
4. The POSW does not turn off (D) within 7.5 seconds (8 sec before May '88 production) after POSW turned on.

5(*1). The FDOUTSW does not turn on (E) within 10 seconds after POSW turned on.

6(*1). The FDOUTSW does not turn off (F) within 8 seconds after FDOUTSW turned on.

7. The POSW is on (G) within 3 seconds after PSS turned on.
8. The PISW has already turned on when HFSW is on.
9. The HFSW is on from the time PFS is on to the time PSS is on.

10(*2). When PISW, POSW, or FDOUT is turned on in other than the print cycle.

11. The PISW has already turned on when PFS is turned on.
12. When HFSW is turned on with an off state of PISW, when PSS is on.
13. When $\overline{\text{PAGE}}$ is sent when HFSW is on and PISW is off.

NOTES: *1: When the paper release mode is in the face down mode.

*2: PJ is not established when HFSW and PISW are on at the same time.

Before '88 May production, the following specifications are added to the above specifications.

- When the Face Down SW is switched in a 1.0 second period that POSW turned on and two seconds after POSW turned off.
- When changed from the face up mode to the face down mode in the multipage mode.

(2) PO (paper out)

An error that occurs when a misfeed occurred.

(Criterion)

When PISW is not turned on within 2.5 seconds after PFS is turned on.

(3) CC (toner empty)

A CC error will be established when one of the conditions below is met. This error may be evoked when toner empty is sensed or when the toner cartridge is not installed on its own position.

(Criterion)

1. When TE does not go low continuously for more than one second within about 120 seconds after the outset cycle begins.
2. TE is sampled at every second during the print cycle. If a high state of TE is recognized eight times out of ten TE signals sampled, a single page undertone is established. If this happens continuously for two pages, the current print cycle is extended for a maximum of 120 seconds during which time toner is supplied.

   When the TE signal does not go low continuously for more than one second for the toner supply conducted for a maximum 120 seconds period.
3. When CMISSW (toner cartridge missing SW) is off.

(4) PC (photoconductor cartridge life over)

This error implies that the photoconductor came to the end of its life.

If it occurred in a course of the print cycle, the error is displayed after termination of that cycle.

(Criterion)

1. When the photoconductor cartridge life counter reached -00000 or -2000 during the print cycle.
2. When the photoconductor cartridge life counter is in a negative value at power on or $\overline{\text{PRIM}}$ is received from the ICU. Depression of the CLEAR key is acceptable if not above -2000.

(5) dL (developer cartridge life over)

This error implies that the developer cartridge came to the end of its life.

(Criterion)

1. When the developer cartridge life counter reached -

   00000 or -1000 during the print cycle.
2. When the developer cartridge life counter is in a negative value at power on or $\overline{\text{PRIM}}$ is received from the ICU. Depression of the CLEAR key is acceptable if not above -1000.

(6) OH (overhaul)

This error implies that the print engine reached the overhaul period. If occurred in a course of a print cycle, the error is displayed after termination of that cycle.

(Criterion)

1. When the overhaul counter reached -00000 or -10000 during the print cycle.
2. When the overhaul counter is in a negative value at power on or $\overline{\text{PRIM}}$ is received from the ICU. Depression of the CLEAR key is acceptable if not above -10000.

(7) dO (door open)

This error occurs when either the face down stacker or the front door is open.

(Criterion)

When the upper safety switch or the face down open switch is off.

(8) P1 (PCU ROM error)

(Criterion)

When an error is encountered after the PCU ROM was tested in the sumcheck mode at power on or when the $\overline{\text{PRIM}}$ signal is received from the ICU.

(9) P2 (PCU RAM error)

(Criterion)

When an error is encountered after the PCU RAM was tested in the read/write check mode at power on or when the $\overline{\text{PRIM}}$ signal is received from the ICU.

(10) P3 (NVRAM error)

When an error is encountered after the NVRAM was tested in the sumcheck mode at power on or when the $\overline{\text{PRIM}}$ signal is received from the ICU.

(11) P4 (serial communication error)

(Criterion)

When an overrun error or framing error is encountered upon the time PCU received CMD from the ICU.

(12) C1 (optical system error)

A C1 error will be established when one of the following is met.

1. Laser diode fails to activate.
2. An overcurrent is supplied to the laser diode.
3. The laser beam detector is not operating properly.

(Criterion)

1. When BD interrupt is caused while $\overline{\text{OSSTT}}$ is at a high level.
2. When BD interrupt is not applied within 5.0 seconds after $\overline{\text{OSSTT}}$ was forced low.
3. When $\overline{\text{LDABN}}$ goes to a low level.

(13) C2 (main motor defective)

This error occurs when an irregular rotation is found in the main motor.

(Criterion)

1. When $\overline{\text{MMTLK}}$ does not go low within 1.5 second after the main motor turned on.
2. When a high state of $\overline{\text{MMTLK}}$ is recognized continuously for four times sampled at every 0.5 second after $\overline{\text{MMTLK}}$ has turned low after the main motor turned on.

(14) C3 (polygonal motor defective)

This error occurs when an irregular roation is found in the polygonal motor.

(Criterion)

1. When $\overline{\text{PMTLK}}$ does not go low within 15 seconds after the polygonal motor turned on.
2. When a high state of $\overline{\text{PMTLK}}$ is recognized continuously for four times sampled at every 0.5 second after $\overline{\text{PMTLK}}$ has turned low after the polygonal motor turned on.

(15) C4 (heater high temperature)

This error is encountered when the heater lamp temperature is high.

(Criterion)
When a low state of $\overline{\text{MTH}}$ is recognized.

(16) C5 (heater low temperature)

This error is encountered when the heater lamp temperature is low.

The C5 error will be established when one of the following is met.

(Criterion)
1. When a low state of HTL is recognized continuously for more than 3 seconds during the print cycle or printer ready.
2. When WT does not go high within the prescribed time during the warmup time (variable to a maximum 99 seconds, according to the main motor rotating time in the outset cycle).

(17) C6 (thermistor open)

This error occurs when a failure is in the thermistor.

(Criterion)
When a low state of $\overline{\text{THO}}$ is recognized.

9-7. Manual feed mode

It is possible with the JX9300 to manually supply paper through the manual paper feed slot, in addition to cassette paper feed.

Manual paper feed may be done except when an error occurs (except for PO error). For manual paper feed in the print cycle, paper must be supplied when the trail edge of the preceding paper has passed over the PISW. A PJ error will be evoked, if the paper is inserted through the manual feed slot before that time.

When paper is inserted manually during the outset cycle or print cycle, the leading edge of the paper is held between the PISW and the PS plate depending on when the print paper is inserted through the slot.

The HFSW is activated as the paper is inserted manually though the slot when the main motor is stationary, the main motor starts to run to feed the paper down to the location where the lead edge of the paper actuates the PISW, then the main motor stops.

The discharge lamp is set active while the main motor is running, to avoid carrier fall.

In order to allow multipage print in the manual paper feed mode, a manual feed switch on flag is provided in bit 2 of the STSA control code. The flag is set active when the PISW is activated after the HFSW has turned on. Multipage print will be executed in the manual paper feed mode as the $\overline{\text{PAGE}}$ signal is issued after the ICU checks this flag to be on.

10.POWER SUPPLY CIRCUIT

10-1. General description

This power supply unit consists of an AC block and a DC block. The AC block has a filter and heater lamp driver. The DC block directly rectifies the AC supply to supply the power to the secondary circuit via the converter.

The figure below shows the block diagram

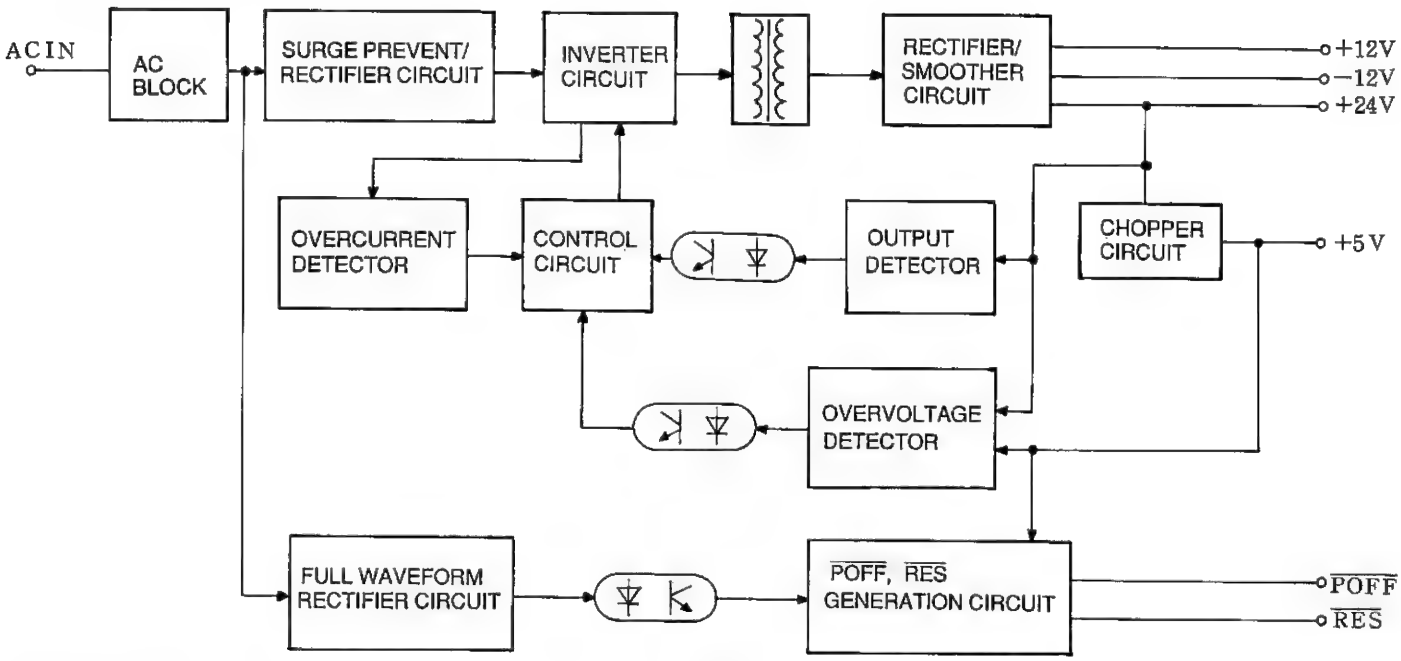


Fig. 1

10-2. Circuit description

(1) AC block

The AC block consists of an AC power supply and a filter to the DC supply. Common mode noise and normal mode flowing in and out of the AC line is removed. Common mode noise generated across the AC line and ground is released to ground through the network composed of C3 and C4. Normal mode noise is a noise overlaid in the AC line and output line and is removed with C1, C2, and L1.

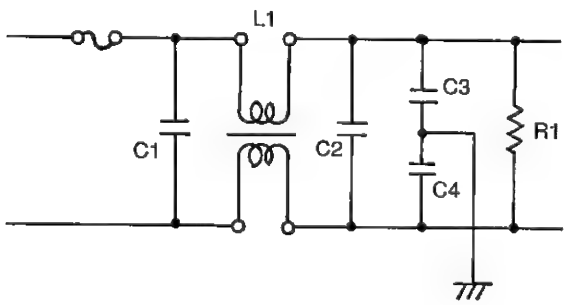


Fig. 2

The network composed of C1 and C2 are used to release the charge.

(2) Surge current preventive circuit

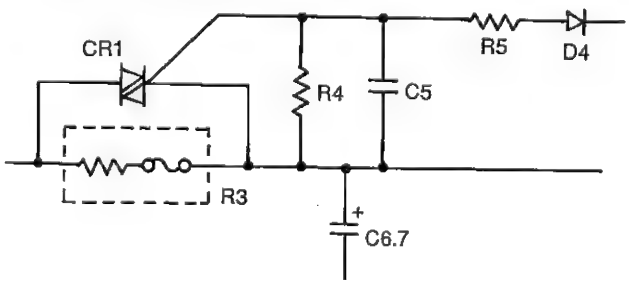


Fig. 3

The direct AC rectifier type is used, a large current may flow on account of the charge current to C6 and C7 at power on and may melt the switch contacts unless CR1 and R3 are not used. To prevent this, C6 and C7 are charged via R3 at power on to suppress the surge current with the resistance of R3.

Function of R3 is canceled after the converter starts oscillating as the triac comes active via D4, and normal heat generation can be prevented.

(3) Rectifier/smoother circuit

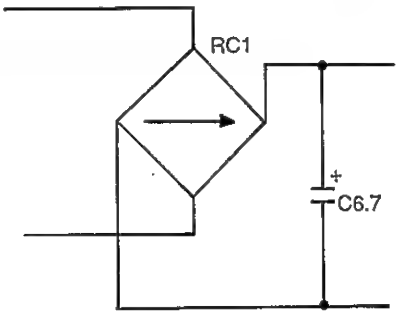


Fig. 4

This circuit is a full waveform rectifier employed to convert the AC source supply to the DC supply voltage.

(4) Inverter circuit (FCC)

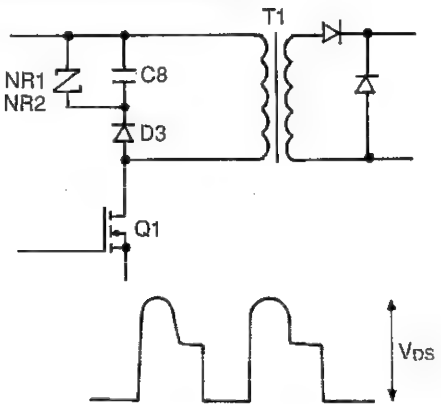


Fig. 5

The forward converter is normally called an FCC. When the FCC, power is supplied to the secondary circuit during the active period of Q1 that repeats ON and OFF which is controlled by a signal from the control circuit. The waveform shown in Fig.5 shows VDS under the normal condition.

D3, NR1, NR2, and C8 are incorporated to absorb counterelectromotive force appearing when Q1 goes OFF.

(5) Secondary circuit rectifier/smoother circuit

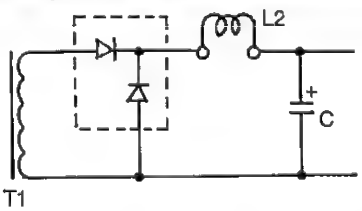


Fig. 6

High frequency pulse created in the inverter is supplied to the secondary circuit via the converter transformer T1 and rectified by the diode and smoothed by L2 and C to deliver the desired voltage.

(6) Control circuit

As shown in Fig.7, a primary side control PWM (pulse width modulation) method is adopted using a power MOSFET for the switching element. The output voltage on the secondary circuit is detected by the output detect circuit whose signal is delivered to Z1 via the primary and secondary isolation photocoupler (PC1) to obtain stable output.

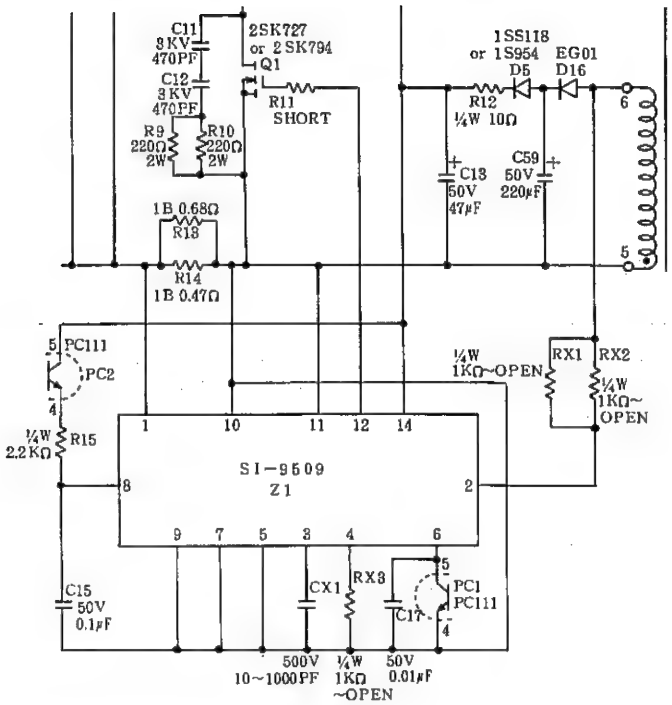


Fig. 7

(7) Overcurrent protect circuit

As the power is supplied from the primary side to the secondary side, the power on the secondary side is dependent on the primary circuit. When an overcurrent is recognized by detecting the Q1 drain current with R13 and R14, a signal is issued to Z1 to decrease the secondary side output (Fig.7).

(8) Chopper circuit (5V)

Oscillation frequency is dependent on the factor of the network composed of C and R which are connected across pins 5 and 6 of Z4, which will generate a stable triangular waveform of about 40KHz. The Z4 is an op amp input, and the detected voltage is compared with the reference voltage to control on and off of Q3 to produce stable output.

For overcurrent, a voltage drop in R66 is divided by the resistors across it and PWM controlled by the op amp within Z4 to control Q3.

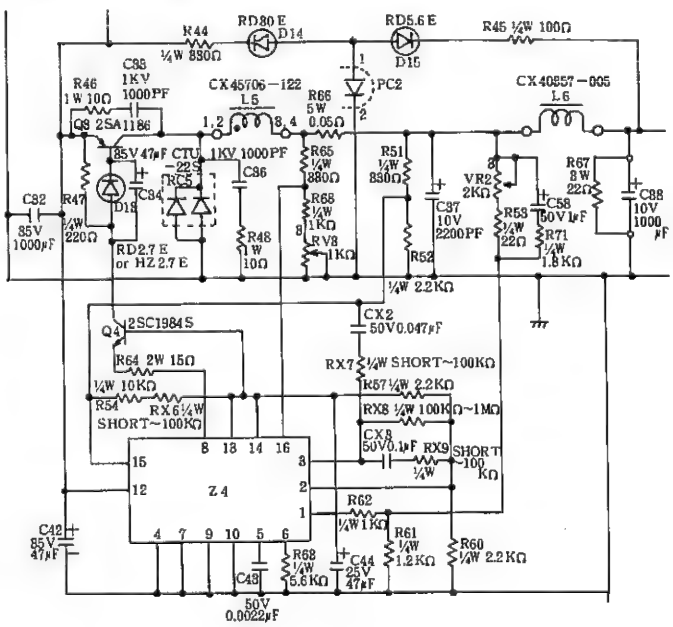


Fig. 8

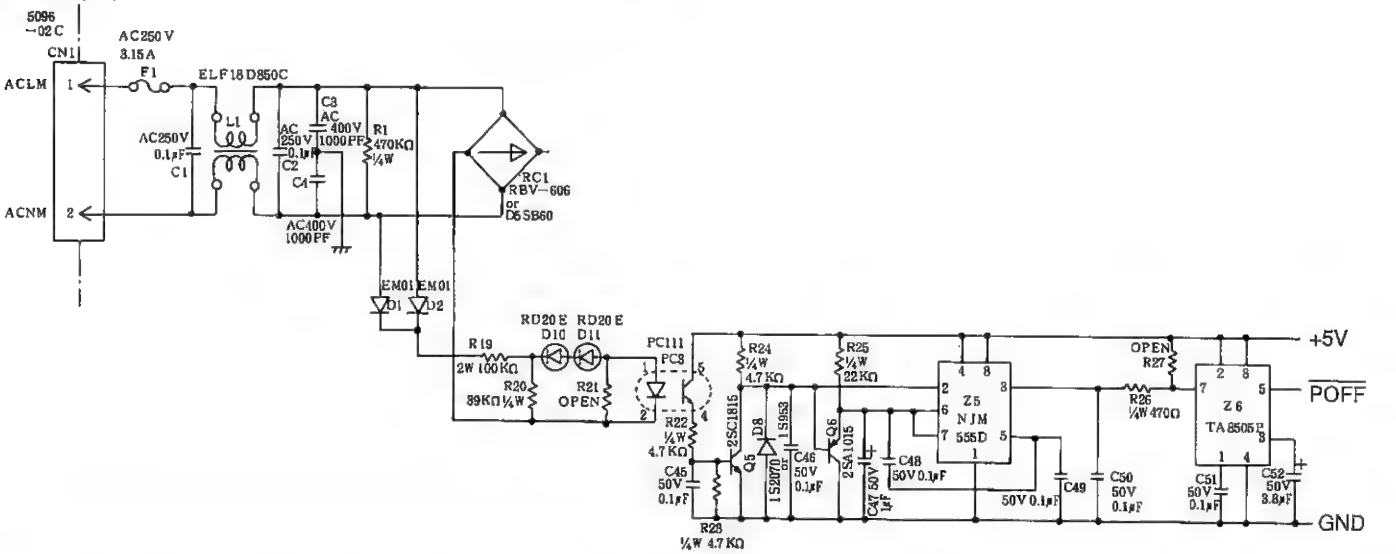
(9) Overvoltage protect circuit

If the 24V or 5V supply system has accidentally generated overvoltage, the state is sent to the primary side control circuit via PC2 as overvoltage in each output is checked by the overvoltage detect circuit (D14, D15).

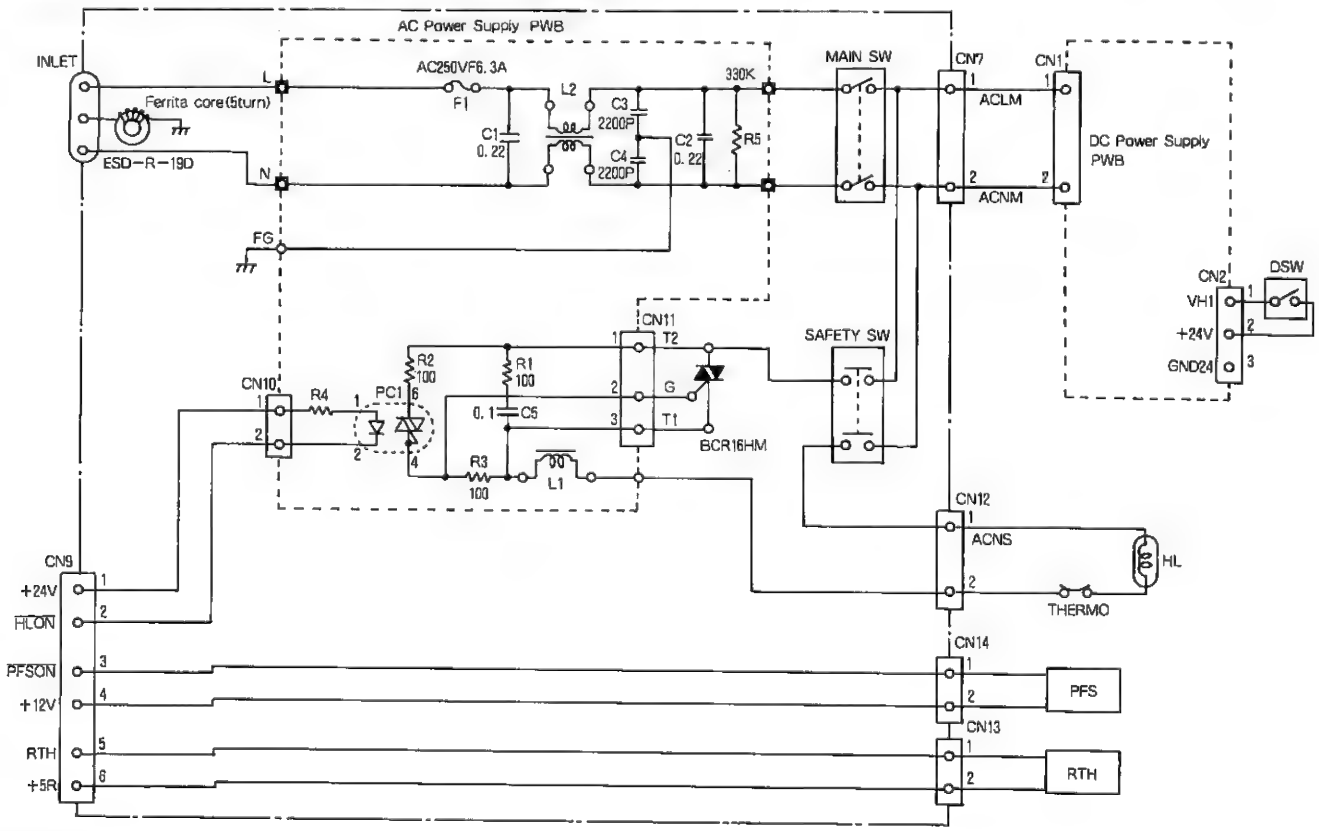
With the transistor side of PC2 turned ON, the circuit within Z1 is activated to stop oscillating.

(10) Signal circuit

AC input voltage is full waveform rectified by D1 and D2 to control on and off of PC3. The information is conveyed to the timer IC Z5 which will set pin 3 high with repeated triggering. Z6 is a voltage monitor IC which will set its output high with a slight delay after receiving input.



(11) Heater Lamp Drive Circuit (AC Power Supply)



(Operation)

a) When control signal $\overline{\text{HLON}}$ from the PCU becomes low, the LED of PC1 lights up. PC1 is a zero cross photo triac which minimize the rush current generated when HL is turned on.

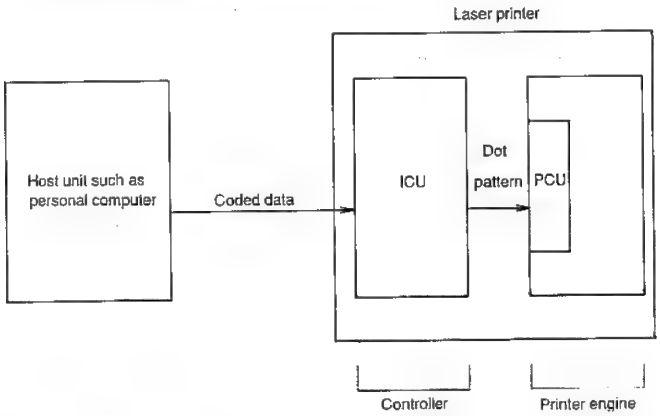
b) When PC1 turns on, the gate of triac (BCR16HM) is driven to turn BCR16HM on.

[14] ICU section

1. About the ICU

1-1. To begin with

The laser printer is used in connection with the host as a personal computer from which the print data is supplied.
The laser printer consists of two major blocks of the controller and the print engine.
The controller consists of the ICU (Interface Control Unit) which is employed to interpret the source print data to create dot pattern information based on the font.
The print engine is the block employed to print the data of the dot pattern information. The print engine includes the laser print mechanism, drum mechanism, and paper feed mechanism which are controlled by PCU (Process Control Unit). Dot pattern information is sent to the laser print block that is controlled by the PCU where the data is converted into laser beams.



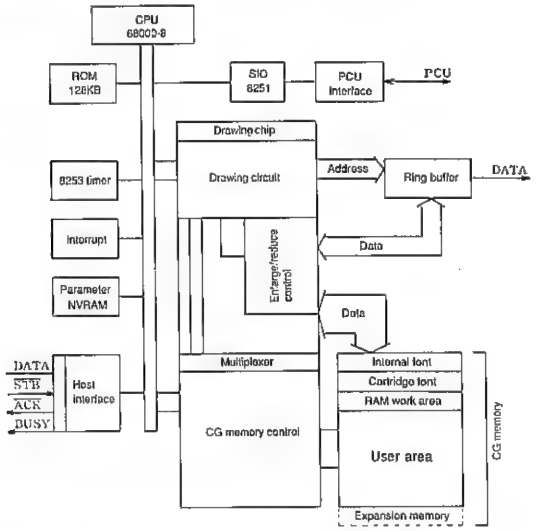
1-2. General

The JX-9300 print controller incorporates the RS232C and Centronics interface for connection with the host and the process controller (PCU) is connected as the video interface.

In this controller is contained the 68000 microprocessor for its CPU, high speed drawing chip for drawing control, and a 0.5MB CG memory which is expandable to 1.5MB, enhancing fast processing of the data received from the host.
In the high speed drawing circuit, address lines are individually provided for the ring buffer and the CG memory, so that extremely high speed processing is enabled as the text data are directly written from the CG memory to the ring buffer.
Download font and image data may be written in the CG as the CPU is enabled to directly access the CG memory.

2. Basic hardware specifications

2-1. Block diagram



2-2. Data flow between blocks

① The print data is received from the host via the interface.

② The CPU stores the received data in the input buffer within the work area.
This action takes place each time data is received through the interface port using the interface interrupt routine.

③ The CPU reads the data from the input buffer and analyse it and stores it in the database buffer within the user area.
The soft font and bit image data received through the interface are also stored in the user area and both are handled the same as the CG data.

④ When the CPU finished creating the database for a page, the drawing start command is issued to the drawing circuit.

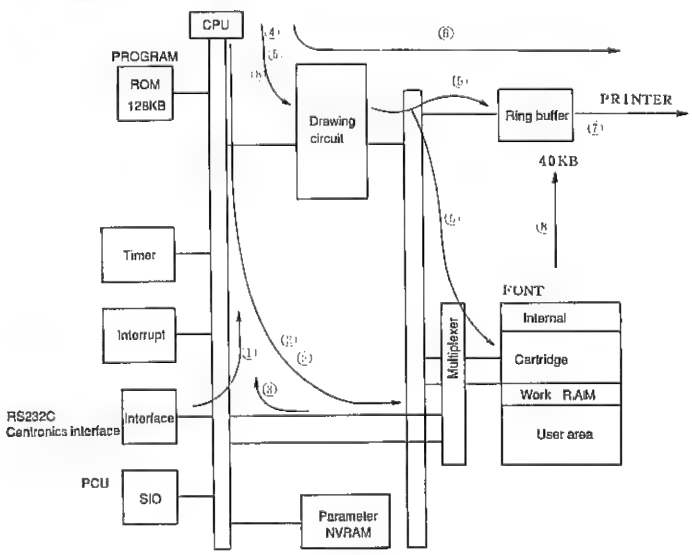
⑤ The CPU reads the database from the data bus buffer according to the request from the drawing circuit and sends them out to the drawing circuit.

⑥ When there is no more data to be written in the ring buffer (40KB, 128 lines), the CPU commands the print engine to start.

⑦ As the engine starts, the data within the ring buffer is read hardware-wise.

⑧ As the CPU monitors vacancy in the ring buffer, database is sent to the drawing circuit.

Above steps ⑤ to ⑧ are repeated until drawing operation is complete for one page.



2-3. Hardware configuration

(1) CPU
68000-8

(2) Drawing processor
16MHz LZ93J16, including the text drawing circuit and DRAM controller

(3) Program ROM
512K EPROM x 2 (128KB)

(4) RAM capacity
256K DRAM x 16 (512KB)

(1) User memory

(2) Work memory

(3) Database memory

(5) CG ROM
Internal font ROM, 64KB

(1) Courier, portrait (Roman8, USASCII, RomanEXT)

(2) Courier, landscape (Roman8, USASCII, RomanEXT)

(3) Line printer, portrait (Roman8, USASCII, RomanEXT)

(4) Line printer, landscape (Roman8, USASCII, RomanEXT)

(6) Timer
8253 x 1

(1) Baud rate generator, for hardware

(2) Interval timer, for software

(3) Scan width counter, for hardware

(7) Ring buffer
256K DRAM X 2
Data are transferred from the user memory to the buffer one character at a time, and sent to the PCU in synchronization with the sync clock from the PCU.

(8) Interface
8255 Centronics interface (PIO)
8251 RS232C interface (SIO)

(9) PCU interface, 8251 SIO
Communication is done with the PCU via the serial interface.

(10) Interrupt
Interrupt may be caused from one of the following blocks.
Timer
Interface (Centronics, RS232C)
PCU circuit
Drawing circuit

(11) Parameter NVRAM
Data related to paper size, country setting, interface condition, etc. are stored in the 8 x 8 NVRAM which can be revised from time to time.

(12) Expansion memory
Expandable up to 1.5MB.

(13) Cartridge font
Credit card type, optional
One slot for the font cartridge

(14) Power supply
5V, 3A. ±12v

(15) PWB
185 x 315mm

3. Software interface

This section discusses about the hardware circuitry interfaced with the software.
Seven lines of interrupts are provided.

3-1. Interrupt

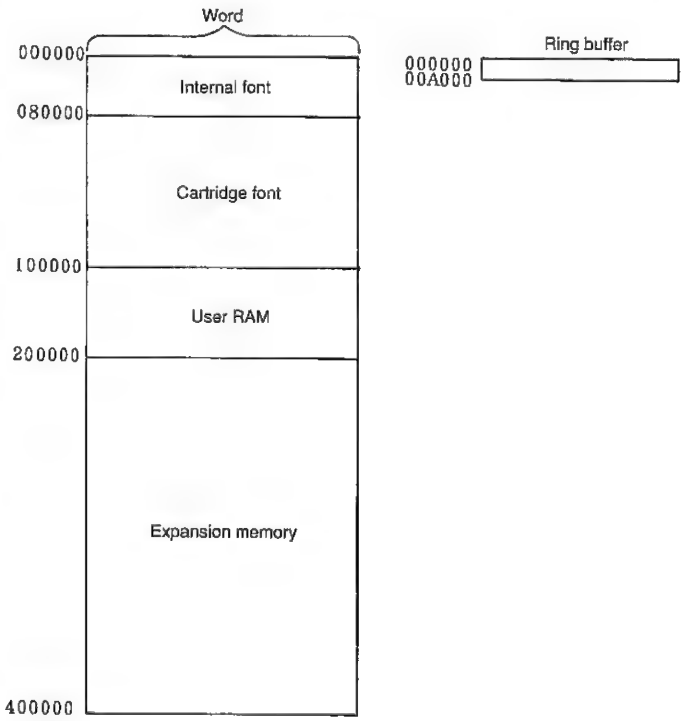
Interrupt levels

INT7	Power-OFF (NM1)
INT6	Not used
INT5	HSYNC
INT4	8253 CH1 (5ms) (Timer)
INT3	Drawing circuit (IRQ)
INT2	PCU interrupt
INT1	Interface interrupt
INT0	Not used

Interrupt is caused in the auto vector mode and exception process is required for the CPU.

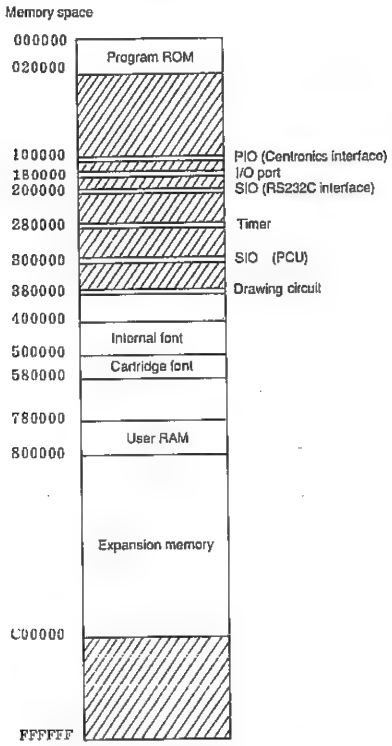
3-2. Drawing memory map

The memory address as seen from the graphic microchip is different from that of the 68000 microprocessor and the address is represented in terms of word address based on the internal font CG.



3-3. CPU memory map

(1) General mapping



(2) Detailed mapping

The following shows address space for the memory and I/O ports.

Item	Space (hexadecimal)	Description
Program ROM	000000(H) 020000(H)	ROM area where the control program is stored.
PIO (Centronics interface)	100000(H) 100006(H)	Used as an 8255 centronics interface.
I/O port	180020(H) 180080(H)	Used to status sens, Interrupt sens, Interrupt enable and NVRAM control.
SIO (RS232C interface)	200000(H) 200002(H)	Used as an 8251 RS232C interface.
Timer	280000(H) 280006(H)	Used as an 8253 timer, baud rate generator, and scan width counter.
SIO (PCU interface)	300000(H) 300002(H)	Used as an 8251 for communication with the PCU.
Drawing processor	380000(H)	Gate array implemented drawing control LSI
Internal font	400000(H) 4FFFFF(H)	A 64KB ROM in which internal font is stored.
Cartridge font	500000(H) 57FFFF(H)	A 128KB, max. cartridge font (option)
User RAM	780000(H) 800000(H)	A 512KB area provided for user memory, work area, and graphic work area
Expansion memory	800000(H) C00000(H)	Memory area can be expanded to 1.5MB, max. when an option is used.

3-4. I/O map

Port	Address	Bit position	Signal name	Description	
8255 Centronics interface control	IN 100000(H)	D15	$\overline{\text{DATA8}}$	Centronics interface receive data	
		D14	$\overline{\text{DATA7}}$		
		D13	$\overline{\text{DATA6}}$		
		D12	$\overline{\text{DATA5}}$		
		D11	$\overline{\text{DATA4}}$		
		D10	$\overline{\text{DATA3}}$		
		D9	$\overline{\text{DATA2}}$		
		D8	$\overline{\text{DATA1}}$		
	OUT 100002(H)	D15	BUSY	Used to set/reset the BUSY signal.	
		D14	PRIM CLR	Used to clear latch of $\overline{\text{INPUT PRIM}}$.	
		D13	ACK	ACK output port	
		D12	PE	Paper empty signal output port	
		D11	SLCT	Select signal output port	
		D10	$\overline{\text{FAULT}}$	Fault signal output port, active state of signal is represented by "0".	
		D9			
		D8			
	IN 100004(H)	D15	Auto LF	Auto LF signal input	
		D14	SLCT in	SCLT IN signal input	
		D13	IBF	Input buffer full flip-flop output	
		D12	STB	Strobe input	
		D11	INTR	Interrupt output	
		D10	$\overline{\text{PRIM}}$	PRIM signal input	
		D9			
		D8			
	OUT 100006(H)	D15	Functional control	1	Mode select setting
		D14	M1	0	Group A: Mode 1 set
		D13	M0	1	
		D12	PA IN/OUT	1	Port A: set to input
		D11	PC(high order) IN/OUT	1	High order port C: set to input
		D10	MB	0	Group B: Mode 0
		D9	PB IN/OUT	0	Port B: set to output
		D8	PC(low order) IN/OUT	1	Low order port C: set to input
Status sense	IN 180020(H)	D15	INPUT PRIM	Used to receive INPUT PRIM from the Centronics interface.	
		D14	PRDY	Input of PCU interface PRDY signal	
		D13	CG ON	Indicates installed CG cartridge.	
		D12	$\overline{\text{NVRAM-DATA}}$	NVRAM data serial input port	
Interrupt sense	IN 180060(H)	D15	IRQ INT	Receives scroll request interrupt from the drawing processor.	
		D14	T1 INT	Receives interrupt from the timer (interval time).	
		D13	I/F INT	Receives interrupt from the Centronics interface.	
		D12	T0 INT	Receives interrupt from th RS232C interface.	
		D11	HSYNC INT	Receives data transfer sync clock from the PCU.	
		D10	Power-OFF	Power-off interrupt port.	

Port	Address	Bit position	Signal name	Description
Interrupt enable	OUT 180060(H)	D15	CG EN	Cartridge font enable output
		D14	T1 INT EN	8253 channel 1 enable output
		D13	I/F INT EN	Centronics interface interrupt enable output
		D12	SIO INT EN	PCU interface interrupt enable output
		D11	TO INT EN	8253 channel 0 enable output
		D10	IRQ EN	Drawing processor interrupt enable output
		D9	$\overline{BZ}$	Buzzer enable output
		D8	HSYNC INT EN	HSYNC interrupt enable output
NVRAM control	OUT 180080(H)	D15	CS	NVRAM chip select output
		D14	DATA IN	NVRAM data output
		D13	CLOCK	NVRAM data sync output
		D12	$\overline{RECALL}$	NVRAM data recall output
		D11	$\overline{STORE}$	NVRAM data store output
		D10	$\overline{RES}$	Drawing processor clear output
TIMER 8253	IN/OUT 280000(H) Baud rate divide parameter setting (mode 3)	D15		RS232C baud rate divide parameter setting 02(H) . . . 19200BPS 20(H) . . . 1200BPS 04(H) . . . 9600BPS 40(H) . . . 600BPS 08(H) . . . 4800BPS 80(H) . . . 300BPS 10(H) . . . 2400BPS 100(H) . . . 150BPS
		D14		
		D13		
		D12		
		D11		
		D10		
		D9		
		D8		
	IN/OUT 280002(H) Interval timer setting (mode 0)	D15		Basic clock input, 614.4KHz (cycle timer: 1.6276us) By counting the basic clock input, an interrupt is issued when the counter value reaches 0.
		D14		
		D13		
		D12		
		D11		
		D10		
		D9		
		D8		
	IN/OUT 280004(H) Scan width counter setting (mode 1)	D15		Sets up the data length of one raster in terms of bit
		D14		
		D13		
		D12		
		D11		
		D10		
		D9		
		D8		
		D7		
		D6		
		D5		
		D4		
		D3		
		D2		
		D1		
		D0		

Port	Address	Bit position	Signal name	Description
TIMER 8253	OUT 280006(H) Control port	D15	SC1	Specify the counter to send the mode word.
		D14	SC0	

Counter select		Function
0	0	Counter 0 — Mode 3 RS232C baud generator
0	1	Counter 1 — Mode 0 Timer 1 interrupt
1	0	Counter 2 — Mode 1 Setting up the length for one raster, in terms of byte per page

		D13	RL1
		D12	RL0

Select counter accessing mode.

Counter accessing mode	
0	0 — Count latch
0	1 — LSB read/write
1	0 — MSB read/write
1	0 — Read/write in order of LSB and MSB

		D11	M2
		D10	M1
		D9	M0

Select counter operating mode.

Mode setting			
0	0	0	Mode 0
0	0	1	Mode 1
x	1	0	Mode 2
X	1	1	Mode 3
1	0	0	Mode 4
1	0	1	Mode 5

		D8	Count mode: 0; binary, 1; BCD — Specifying count data to be binary or BCD.
RS232C 8251	OUT 200002(H)	D15	S2
		D14	S1

Setting stop bit length	
0	0 — Not used.
0	1 — 1 bit
1	0 — (Not used)
1	1 — 2 bits

	D13	EP — Even Parity (1: even, 0: odd)
	D12	PARITY-EN — Parity enable
	D11	L2
	D10	L1

Setting character bit size	
0	0 — (Not used)
0	1 — (Not used)
1	0 — 7 bits
1	1 — 8 bits

Port	Address	Bit position	Signal name	Description	
RS232C 8251		D9	B2	1	
		D8	B1	0	Baud Rate Factor setting baud rate dividing ratio (Fixed to 1/16)
	OUT 200002(H)	D15	EH	Not used	
		D14	IR	Internal reset (must be executed before turning on PS.)	
		D13	RTS	RTS signal	
		D12	ER	Status word error reset	
		D11	SBRK	Send brake TxD fixed to 0	
		D10	RxE	Receive enable	
		D9	BTR	BTR signal output, causes $\overline{\text{DTR}}$ low.	
		D8	TxEN	Send enable	
	IN 200002(H)	D15	DSR	DSR (Data Set Ready) signal input	
		D14	SYNDET/3D	Not used	
		D13	FE	Framing error (stop bit detect not enabled)	
		D12	OE	Overrun error	
		D11	PE	Parity error	
		D10	TxE	Transmit buffer empty	
		D9	RxRDY	Data receive enabled (receive interrupt)	
		D8	TxRDY	Send enabled used for transmit end interrupt signal	
	OUT 200000(H)	D15	SD8	RS232C interface transmit data	
		D14	SD7		
		D13	SD6		
		D12	SD7		
		D11	SD4		
		D10	SD3		
		D9	SD2		
		D8	SD1		
	IN 200000(H)	D15	RD8	RS232C interface data	
		D14	RD7		
		D13	RD6		
		D12	RD5		
		D11	RD4		
		D10	RD3		
		D9	RD2		
		D8	RD1		

Port	Address	Bit position	Signal name	Description	
SIO (PCU) 8251	OUT 300002(H)	D15	S2	"0"	Sets to the stop bit size 1.
		D14	S1	"1"	
		D13	EP	x	
		D12	PARITY-EN	"0"	No parity
		D11	L2	"1"	
		D10	L1	"1"	
		D9	B2	"1"	Data size sets to 8 bits. Baud rate sets to 1/64 (9600bps) Basic clock 614.4KHz divided into 1/64.
		D8	B1	"1"	IN 300002(H) Status read
	IN3000002(H)	D15	DSR	$\overline{\text{READY}}$	PCU $\overline{\text{READY}}$ input
		D14		Not used.	
		D13	FE	Framing error	
		D12	OE	Overrun error	
		D11	PE	Parity error	
		D10	TXE	Transmit buffer empty	
		D9	RXRDY	Data receive, cause for PCU interrupt.	
		D8	TXRDY	Receive enable	
	OUT 300002(H) Command	D15	EH	Not used	
		D14	IR	Internal reset executed at power on.	
		D13	RTS	$\overline{\text{PRIM}}$	PRIM signal to the CPU
		D12	ER	Error reset	
		D11	SBRK	Send break character fixed to 0.	
		D10	RXE	Receive enable	
		D9	DTR	$\overline{\text{PAGE}}$	PAGE signal to the CPU.
		D8	TXEN	Send enable	
	OUT 300000(H)	D15	SD8	Transmit data (CMD) to the PCU.	
		D14	SD7		
		D13	SD6		
		D12	SD5		
		D11	SD4		
		D10	SD3		
		D9	SD2		
		D8	SD1		
	IN 300000(H)	D15	RD8	Receive data from the PCU (STS)	
		D14	RD7		
		D13	RD6		
		D12	RD5		
		D11	RD4		
		D10	RD3		
		D9	RD2		
		D8	RD1		

$\overline{\text{READY}}$: Indicates that the PCU is in the ready to print condition.

$\overline{\text{PRIM}}$: Initialize request signal to the PCU.

$\overline{\text{PAGE}}$: Print start request signal to the PCU.

Framing error: Caused if the stop bit was not correctly recognized.

Overrun error: Caused if the CPU speed is slower than the baud rate received, and the received data are lost in this case.

Port	Address	Bit position	Signal name	Function
Drawing processor	OUT 380000(H) Control register address	D15		Font address
		D14		Font address
		D13		
		D12		
		D11		HPOS
		D10		
		D9		
		D8		
		D7		VPOS
		D6		
		D5		
		D4		
		D3		
		D2		
		D1		
		D0		

Font address

Character height

0 0 0 0 0

Start drawing

End drawing

Character width

Bold

Vertical magnification ratio

Horizontal magnification ratio

Data send to the same address at a time.

Port	Address	Bit position	Signal name	Function
Drawing processor	IN 380000(H) Status register address	D15	BUSY	In drawing processing, data transfer not enabled.
		D14	$\overline{\text{Buffer Full}}$	Ring buffer full, drawing processing not enabled.
		D13	$\overline{\text{ERROR}}$	Overrun
		D12		Not used.
		D11		
		D10		
		D9		
		D8		
		D7		
		D6		
		D5		
		D4		
		D3		
		D2		
		D1		

4. Drawing processor

The drawing processor is a gate array composed of 5000 gates. Its internal consists of the text drawing circuit, memory address bus, and the memory control generating DRAM controller.

It has four external interface buses which are shown in Fig.4-1.

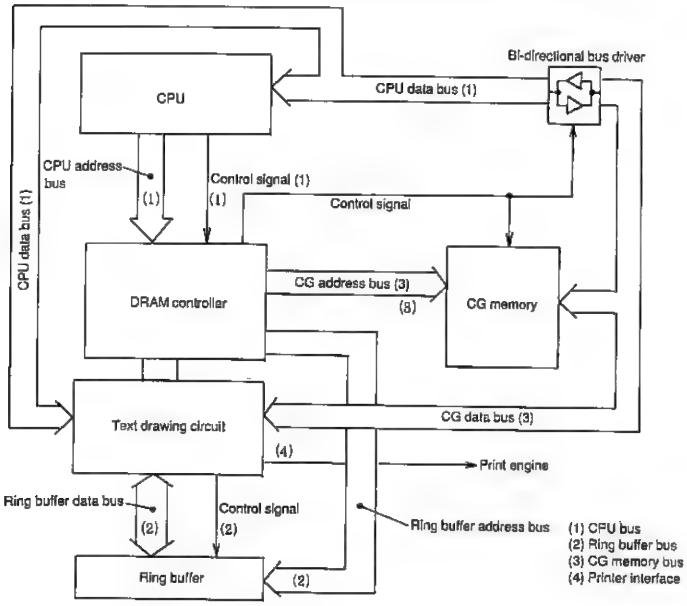


Fig. 4-1. Drawing processor external bus

The CG memory is accessed by the CPU and the drawing circuit, the DRAM controller selects accessing from the CPU and the drawing circuit.

Address bus is selected within the DRAM controller and data bus within the bidirectional bus driver.

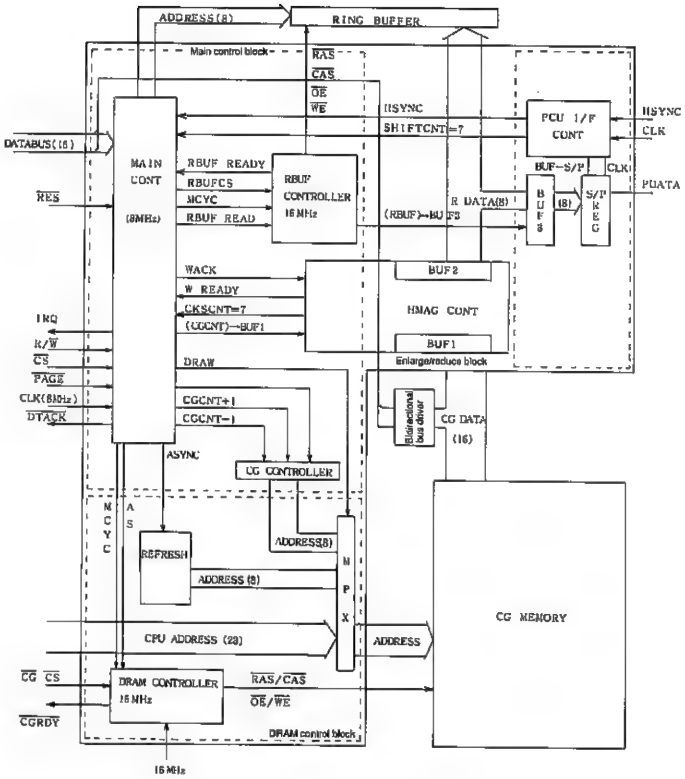
The drawing circuit has the first access privilege.

When the drawing circuit accesses the ring buffer, the ring buffer data bus of (2) and the ring buffer address bus are used.

Video signal to the print engine is transferred from the drawing circuit via the printer interface of (4).

- Drawing processor block diagram

■ The drawing processor is implemented in the gate array and it can be divided into four blocks of ① main control block, ② DRAM control block, ③ enlarge/reduce block, and ④ PCU interface block.
The main control block is used to interpret the CPU command, interrogates buffer full and overrun error, and is used to form drawings.
The DRAM control block is employed to control the drawing processor connected CG memory and the ring buffer DRAM which can be accessed by both drawing circuit and CPU.
The enlarge/reduce block is employed to write the contents of the CG memory into the ring buffer according to the direction from the main control block.
The PCU interface block has the function to convert the given data into a serial equivalent according to the PCU clock and sync signal (HSYNC) to send it to the PCU.



Drawing processor block diagram

4-1. About the text drawing circuit

The drawing circuit receives through the CPU bus ① the font stored CG memory address (which will be simply referred to as source address, hereinafter), ② address of the ring buffer to make a drawing (which will be simply referred to as a destination address, hereinafter), ③ size of font, and ④ enlarge/reduce data. Data transferred from the source memory are processed according to the above and written in the ring buffer via the ring buffer bus.
Since only a part (128 dot line) is provided in the ring buffer, different from a full page memory, it will repeat writing new data after accessing the ring buffer.
Read is achieved in synchronization with the external sync signal (HSYNC) and transferred to the external print engine at every video clock.

4-2. DRAM controller

The DRAM controller of the drawing processor controls and refreshes the DRAM of the CG memory and ring buffer.
The control will access ① the CG memory DRAM by the CPU and ② access the CG memory and ring buffer DRAM by the drawing circuit, changing the bus.
Signals are generated to control the CG memory and drawing circuit.

4-3. Ring buffer operational theory

① When the CPU directs the drawing circuit to start, the bit image data is written in the ring buffer one character at a time.

② Bit image data is repeated to write. This figure shows when the ring buffer (40KB, 128 lines) is fully occupied.

③ Bit image data within the ring buffer are read to the drawing circuit. (The drawing circuit transfers the data to the print engine in synchronization with the external sync signal HSYNC.)

④ The figure shows when lines "m" are open (available) after the bit image data are read and that it is ready to accept a new bit image data of "m" lines.

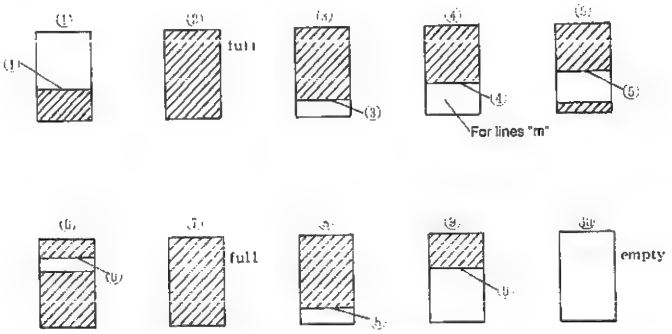
⑤ The figure shows when the first few lines of the new bit image data are written, while the data is read at the same time.

⑥ This figure shows that a bit image data is written after bit image data of "m" lines have been written.

⑦ The figure shows that the ring buffer has been fully occupied after the new bit image data were written after the previous bit image data have been read.
Steps ③ thru ⑥ are repeated hereafter.

⑧ & ⑨ As no more bit image data is written, the area begins to open.

⑩ The ring buffer became empty after all the bit image data is read by the drawing circuit.



4-4. Print data transmission method

① When the CPU finishes creating the database for a page, the drawing circuit is commanded to send $\overline{\text{PAGE}}$ to the print engine with a low state of $\overline{\text{PAGE}}$.

② When the PCU within the print engine received $\overline{\text{PAGE}}$, the engine is started and the HSYNC signal is issued to the drawing circuit.

③ As the drawing circuit receives the command to start the drawing circuit, the database within the ring buffer is read and the data is sent to the print engine in synchronization with the input clock, each line synchronizing with HSYNC.

④ Data continues to be transferred to the print engine.

⑤ When all data have been transferred, the CPU sets $\overline{\text{PAGE}}$ high for the print engine. With this appearance of $\overline{\text{PAGE}}$, the PCU disables HSYNC output so that the drawing circuit stops transferring data to the PCU.

5. NVRAM

The S2430I is a non-volatile CMOSRAM. Data consists of 8 words x 8 bits and can be transferred serial on a single data bus. Each bit of the RAM is in pair with a non-volatile EEPROM. Data transfer between the RAM and the EEPROM takes place in response to a command from the processor, $\overline{\text{STORE}}$, and $\overline{\text{RECALL}}$. While the non-volatile data are stored in the EEPROM, the RAM data are read independently. The NVRAM is used to store the parameter for paper size, emulation.

6. Expansion memory

6-1. General

The expansion memory is connected to the ICU and used as expansion memory for the user RAM area.

Using twelve chips of 256K x 4-bit memory, it totals 1.5MB.

6-2. Block diagram

See Fig.6-1.

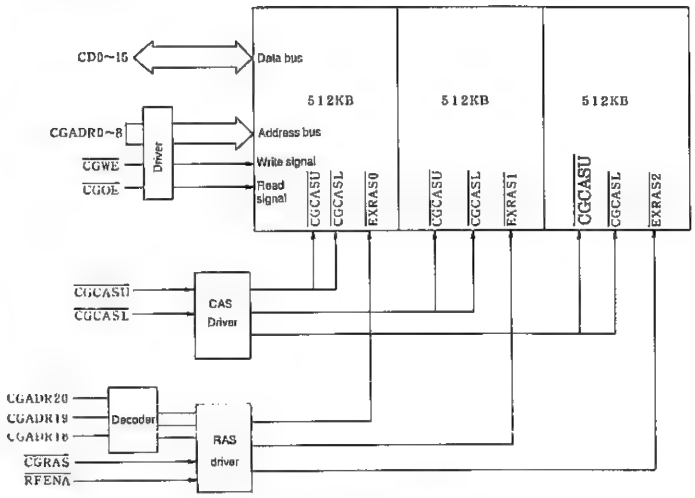


Fig.6-1. Block diagram

6-3. Configuration

The memory board is directly installed above the ICU PWB via the connector.
Twelve pieces of SOJ type memory chips are mounted on the board to constitute the total memory capacity of 1.5MB on 64 x 105mm.

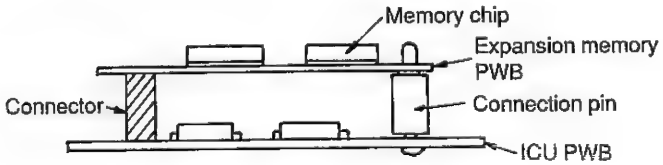
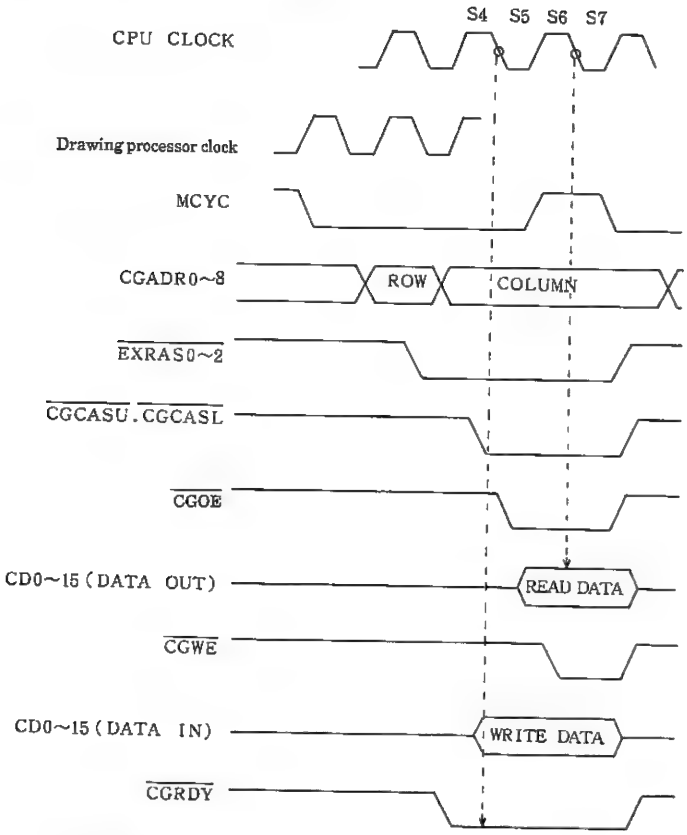


Fig.6-2. Expansion memory connection

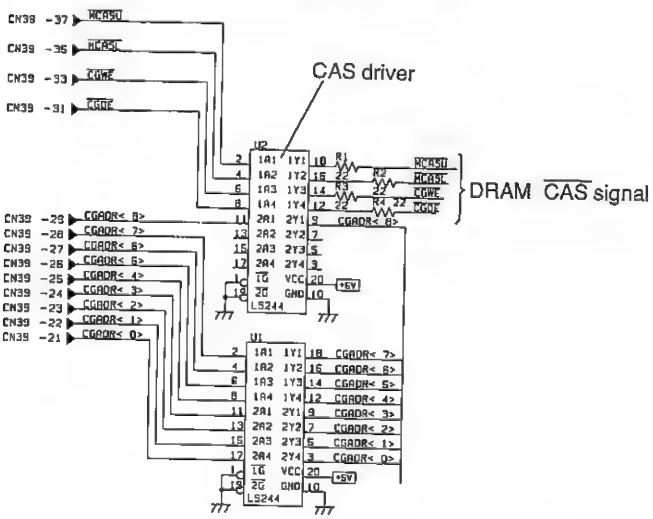
6-4. Operational theory

6-4-1. Access timings



6-4-2. CAS driver

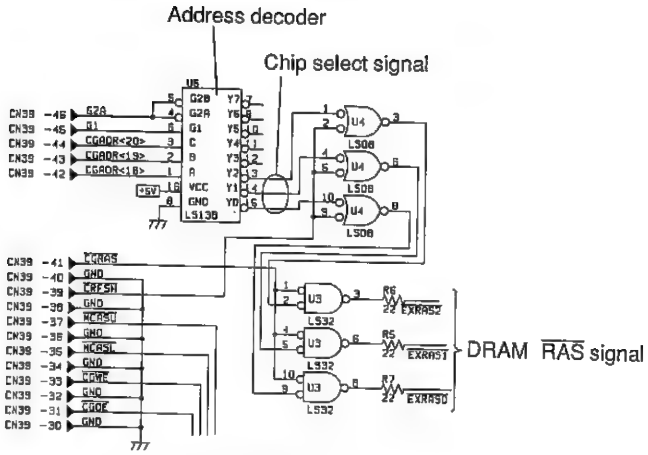
CGCASU and CGCASL are given to the DRAM.



6-4-3. RAS driver

CGADR18 to CGAR20 are decoded to create EXRAS0 to EXRAS2.

As all chips are refreshed at the same time, EXRAS0 to EXRAS2 are issued at the same moment.



6-5. Interfacing signals

CGADR8 to CGADR0 are address signals multiplexed by the ICU.

CGWE:	Memory write signal
CD15 to CD0:	16 data signals
CGCASU:	CAS signal given to the memory which indicates that high order data CD15 to 8 are being accessed.
CGCASL:	CAS signal given to the memory which indicates that low order data CD7 to 0 are being accessed.
EXRAS:	RAS signal given to the memory.
RFENA:	Refresh signal.
CGOE:	Memory read signal.

7. Connector signals

7-1. Centronics connector

CN38

7-2. RS232C connector

CN37

7-3. PCU interface connector

CN36

7-4. Font cartridge connector

CN40

7-5. Expansion memory connector

CN39

(See ICU connector section of circuit diagram)

8. Circuit description

Circuit operation can be explained in three divisions, CPU related, user memory related, and drawing circuit related.

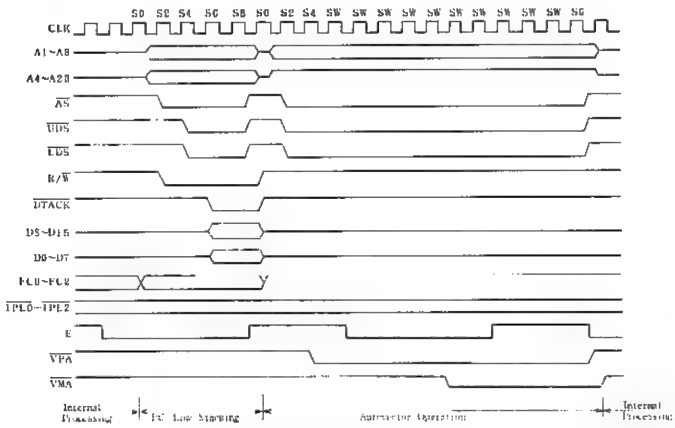
8-1. CPU peripherals

The 68000-08 is used for the CPU and operated under 8MHz.

All interrupts are caused in the auto vector mode, interrupt address is assigned automatically in connection with interrupt level. The interrupt acknowledge signal ACK is supplied to the -VPA line of the CPU. This line indicates to handle it in the auto vector mode when an interrupt is requested.

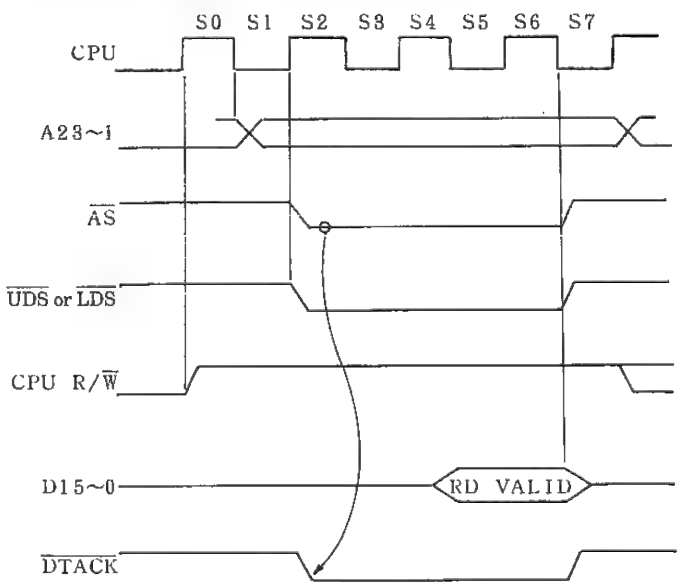
The watchdog timer counts the clock E (0.8MHz) issued by the CPU to cause a bus error. Bus cycle is divided into the read bus cycle, write bus cycle, and interrupt acknowledge bus cycle.

(1) Interrupt bus cycle



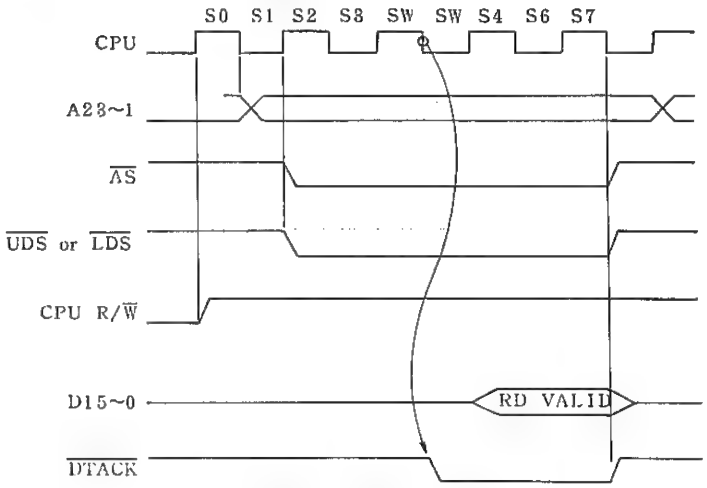
Interrupt acknowledge bus cycle

(2) Read bus cycle-1
Related resource
EPROM (128KB), 8251, 8253, 8255, General I/O



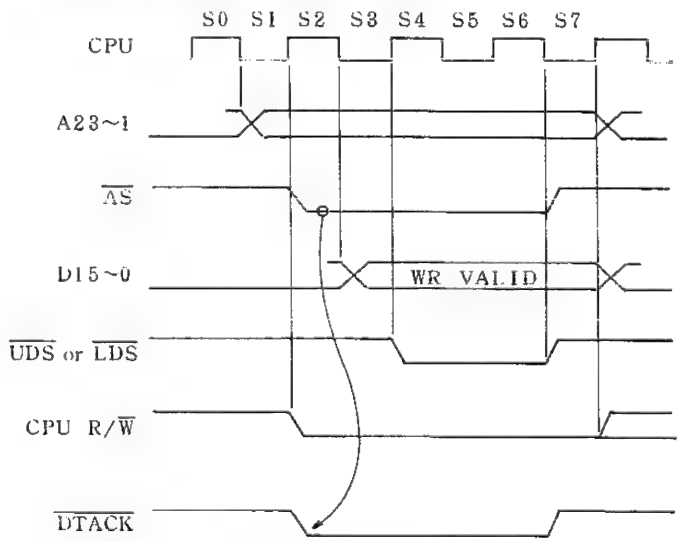
CPU read bus cycle-1

(3) Read bus cycle-2
Related resource
Drawing LSI, CG memory



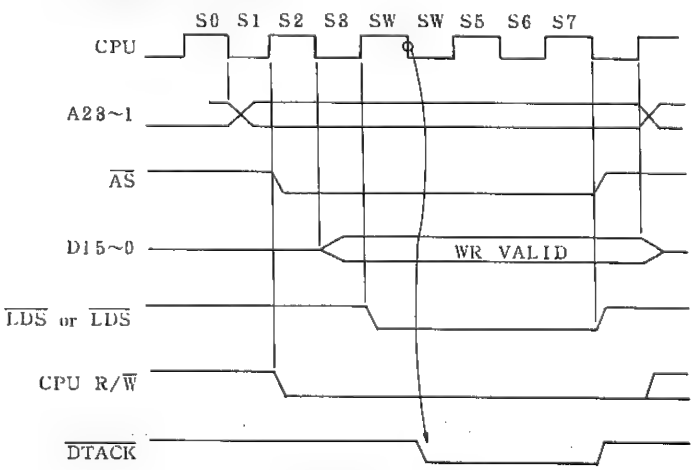
CPU read bus cycle-2 (1 wait)

(4) Write bus cycle-1
Related resource
EPROM, 8251, 8253, 8255, General I/O



CPU write bus cycle-1

(5) Write bus cycle-2
Related resource
Drawing LSI, CG memory



CPU write bus cycle-2 (1 wait)

Address strobe ($\overline{AS}$): This signal indicates that there is a valid address on the address bus.

Read/write (R/$\overline{W}$): This signal defines the data bus transfer as a read or write cycle.

Upper and lower data strobe ($\overline{UDS}$, $\overline{LDS}$):

These signals control the flow of data on the data bus, as shown in Table 8-4-1. When the R/$\overline{W}$ line is at a high, the processor will read from the data bus as indicated. When the R/$\overline{W}$ line is at a low, the processor will write to the data bus as shown.

UDS	LDS	R/W	D8-D15	D0-D7
High	High	–	No Valid Data	No Valid Data
Low	Low	High	Valid Data Bits 8-15	Valid Data Bits 0-7
High	Low	High	Non-valid Data	Valid Data Bits 0-7
Low	High	High	Valid Data Bits 8-15	No Valid Data
Low	Low	Low	Valid Data Bits 8-15	Valid Data Bits 0-7
High	Low	Low	Valid Data Bits 0-7*	Valid Data Bits 0-7
Low	High	Low	Valid Data Bits 8-15	Valid Data Bits 8-15*

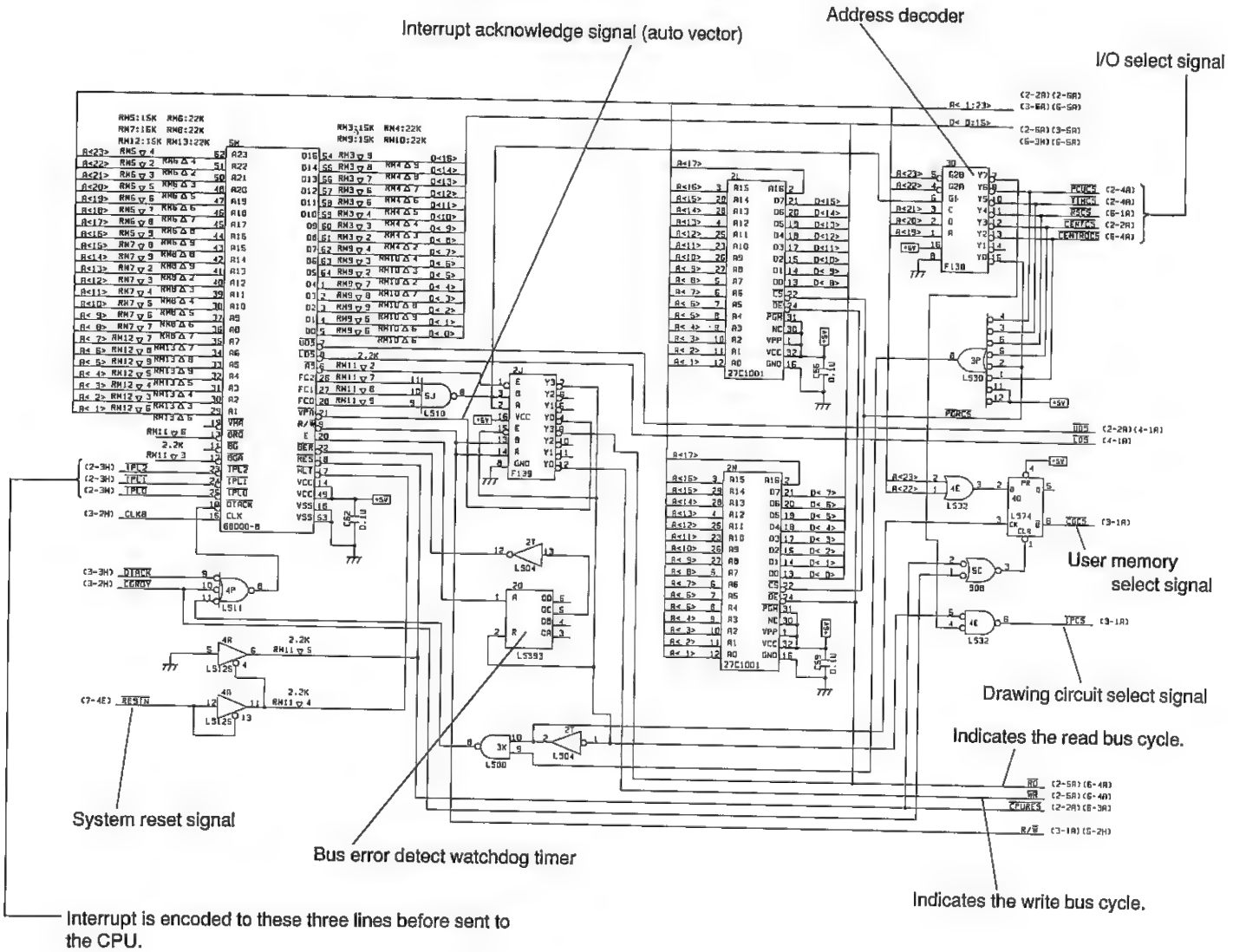
Table 8-4-1

These conditions are results of current implementation. and may not appear on future devices.

* These conditions are result of current implementation. and may not appear on future devices.

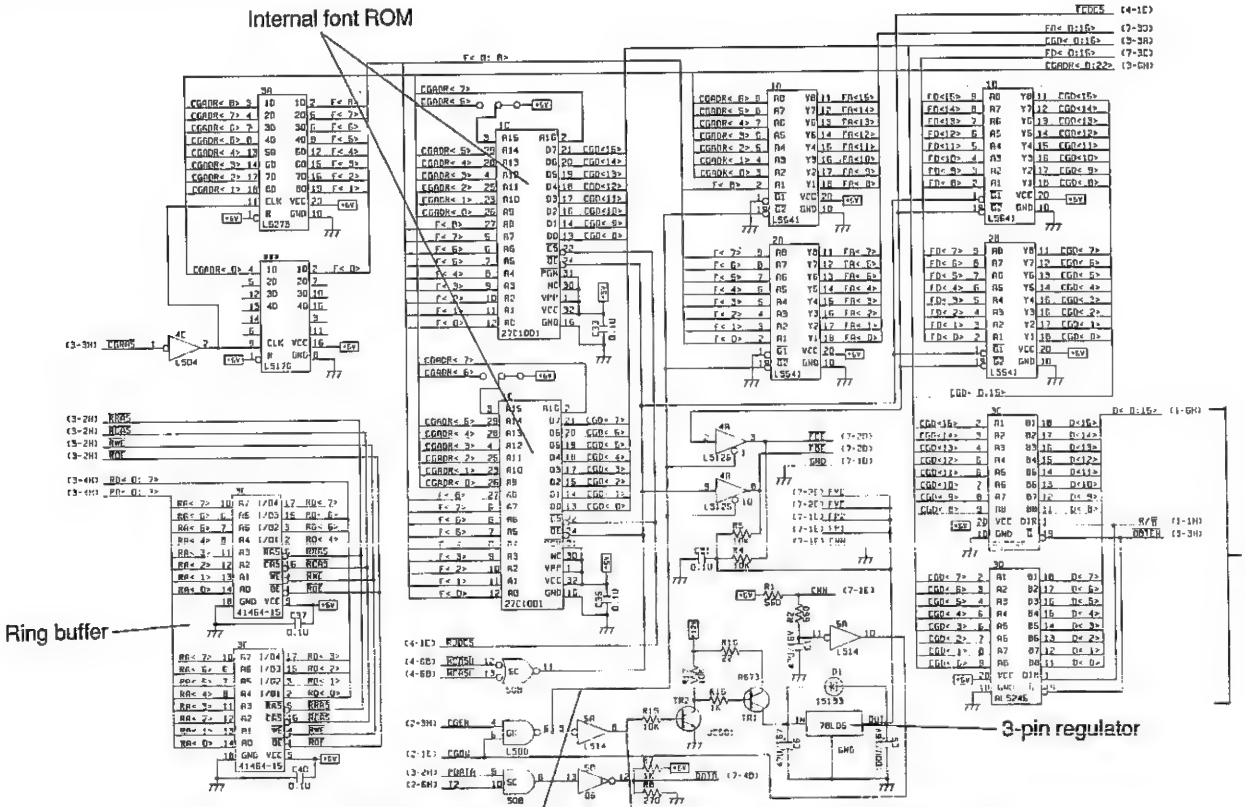
Data transfer acknowledge ($\overline{DTACK}$):

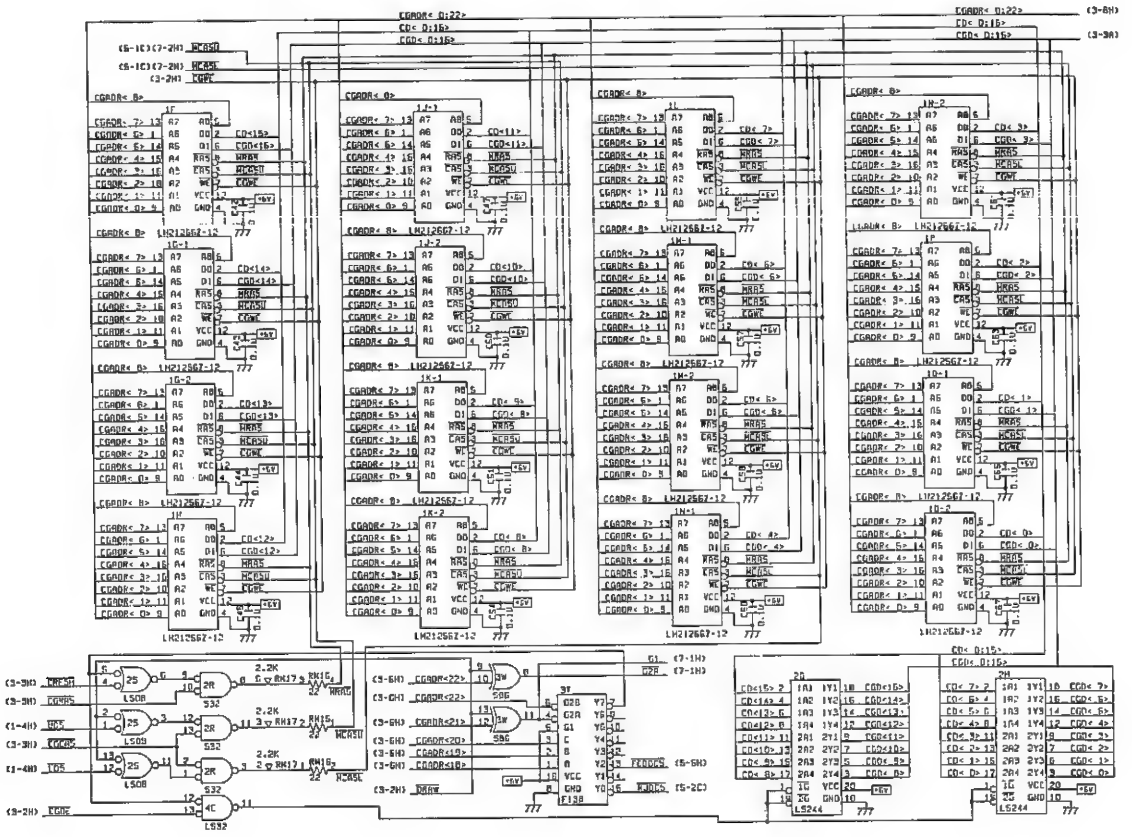
This input indicates that the data transfer is completed. When the processor recognizes $\overline{DTACK}$ during a period of a read cycle, data is latched and the bus cycle terminated. When $\overline{DTACK}$ is recognized during a write cycle, the bus cycle is terminated.



8-2. Memory circuit

The memory circuit consists of the internal font ROM, interface with the cartridge font, read/write enabled RAM, and the ring buffer. The user RAM is used by the CPU for the work RAM, CG RAM, and down load font RAM area.
The ring buffer has another address and data bus as a drawing area, apart from the above memory.

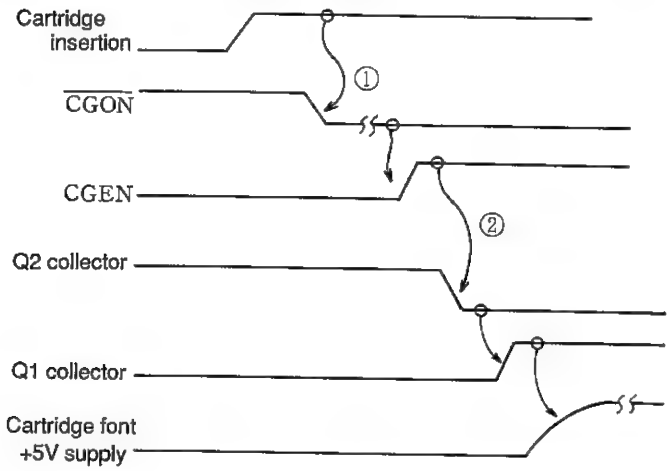




Cartridge font interface

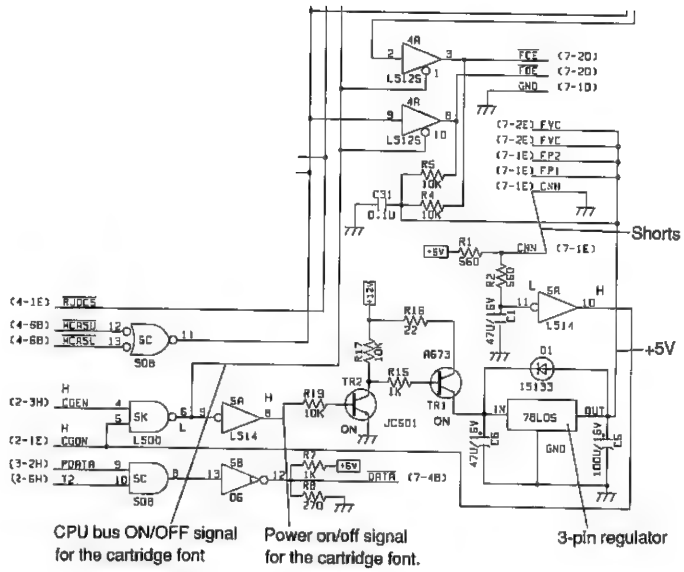
By accessing the character font cartridge in the following sequence, the circuit prevents the cartridge font from being damaged when removing and installing the cartridge font, as well as preventing a CPU malfunction.

Cartridge font power supply sequence

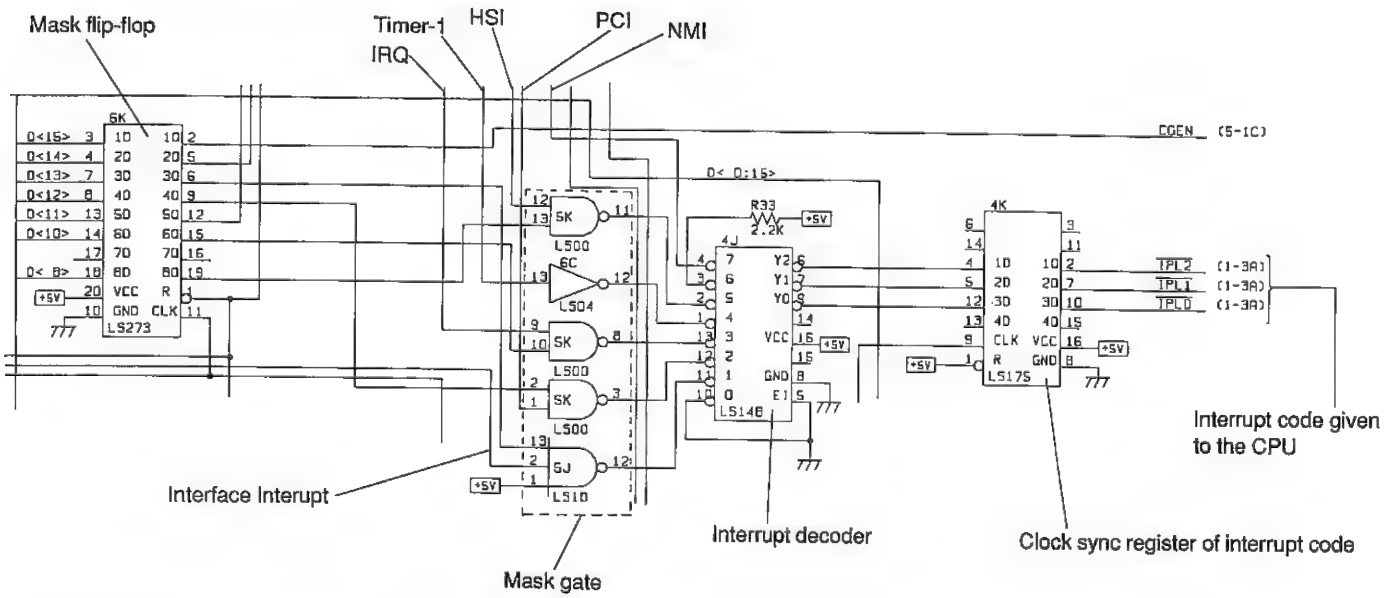


① When the cartridge font is inserted in the machine, pin 6 of CN40 shorts with pin 58. This causes pin 6 to go low level so that CGON is forced high. As this causes $\overline{\text{CGON}}$ to go low, the CPU becomes enabled to access the cartridge font.

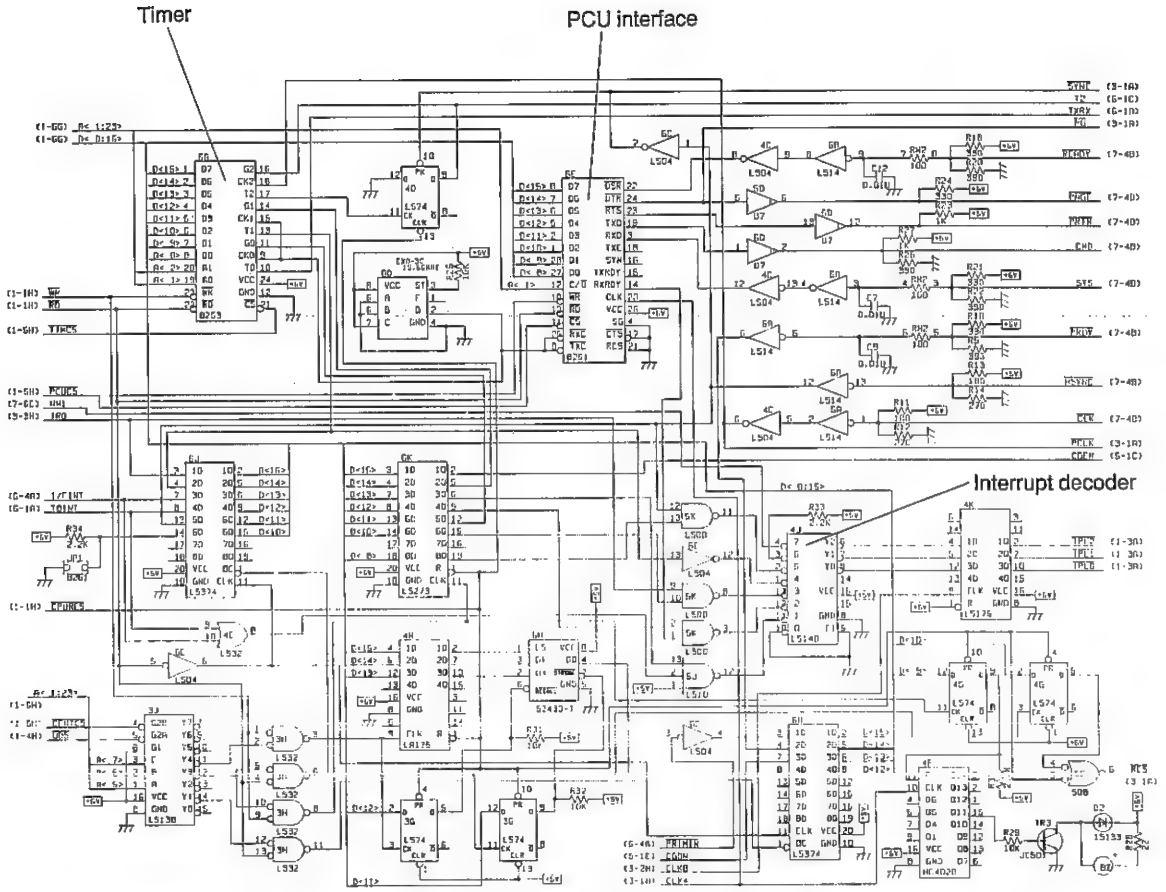
② With a high state of CGEN, the CPU bus becomes enabled and both Q1 and Q2 turns on, so that the +5V is supplied to the cartridge font.



8-3. Interrupt encoder circuit



Interrupt level	Function
Level 7	NMIPower-off interrupt
Level 6	Not used
Level 5	HSYNC interrupt
Level 4	Timer 1 Interval timer interrupt
Level 3	IRQ Drawing processor Graphic LSI interrupt
Level 2	PCU interrupt
Level 1	Interface interrupt
Level 0	Not used



8-4. Drawing processor peripherals

The drawing circuit writes a database (drawing data) in the ring buffer and sends the database within the ring buffer to the PCU.

The drawing circuit interprets a 5-word data from the CPU (68000) and returns the CG data to the ring buffer one character at a time.

The, text drawing processor peripheral circuits are connected with the address data bus from the CPU, CG memory and ring buffer. The RAM area is automatically refreshed, and the CG memory can be read and written from the CPU and via the drawing processor.

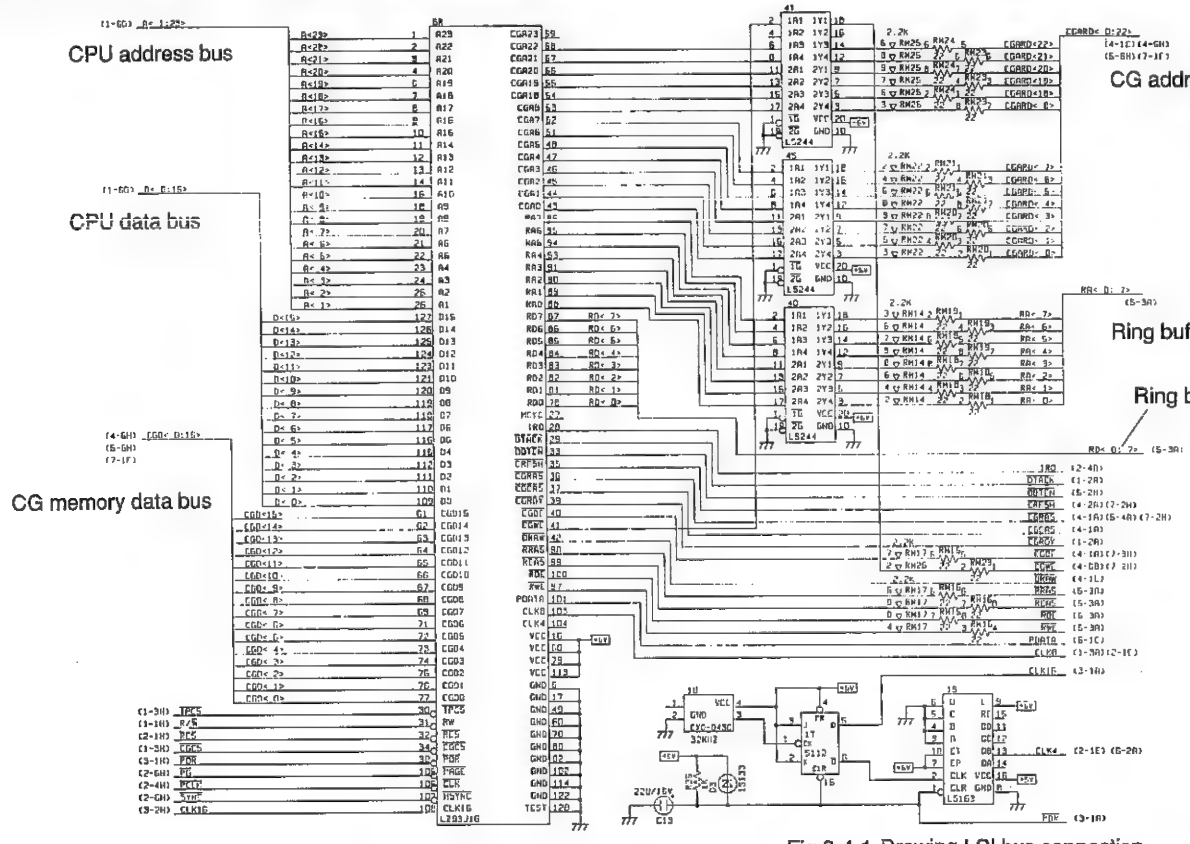
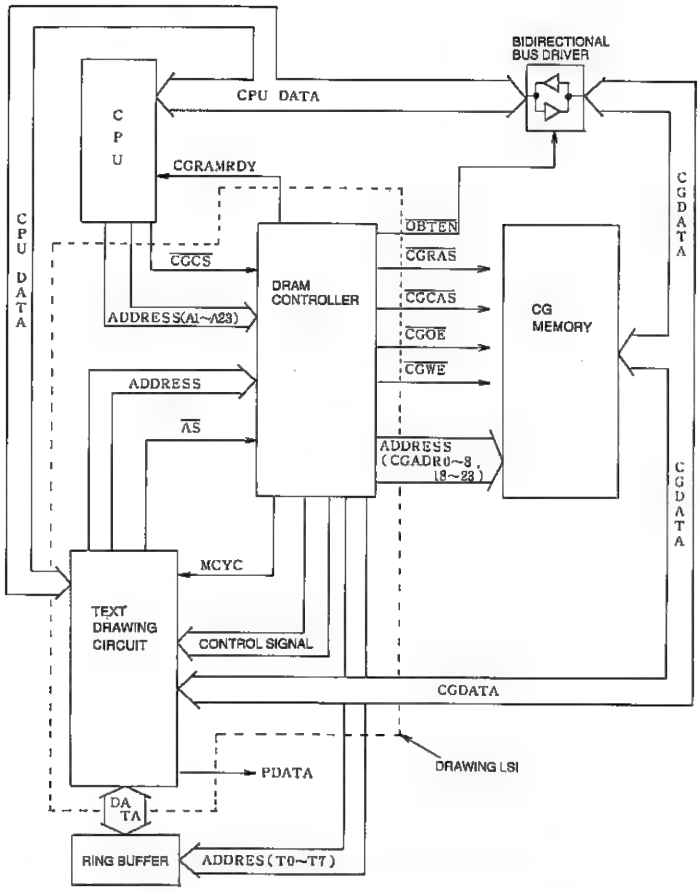


Fig.8-4-1. Drawing LSI bus connection



Drawing LSI peripheral block diagram

Pin assignment and layout

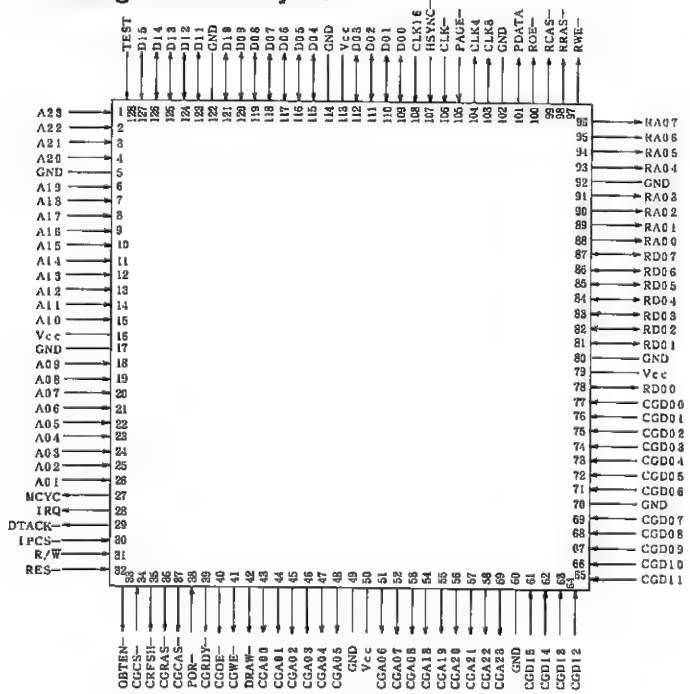


Fig. 8-4-2. Drawing LSI pin layout

Pin functional description

Pins are divided into groups of power supply lines, MPU interface signal lines, DRAM interfacing signal lines, ring buffer interfacing signals, and attribute control signal lines, of which functions are described next.

1. Power supply

   Vcc: Pin numbers, 16, 50, 79, 113

   Vss: Pin numbers, 5, 17, 49, 60, 70, 80, 92, 102, 114, 122

These lines are used to supply power to the drawing processor.

Vcc: = 5V±5%

Vss: = Ground

8-4-1. CPU interface

The CPU data bus is directly connected with text drawing circuit, as well as the CPU address bus. This permits the CPU to make direct accessing to the drawing circuit within text drawing processor.

The CPU interface consists of the following buses.

Address bus (A01 to A23)

Data bus (D00 to D15)

Control signal ($\overline{RES}$, IRQ, R/$\overline{W}$, $\overline{IPCS}$, $\overline{PAGE}$, $\overline{DTACK}$, $\overline{CGCS}$, $\overline{CGRDY}$)

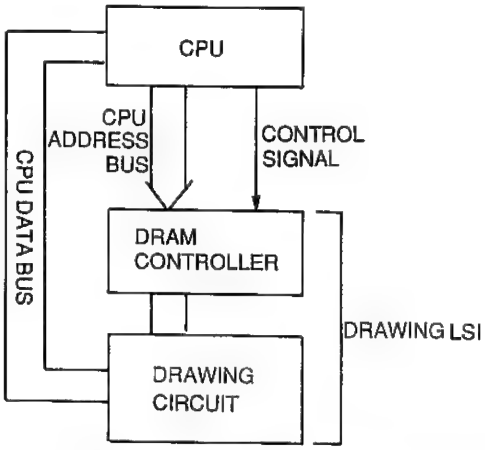
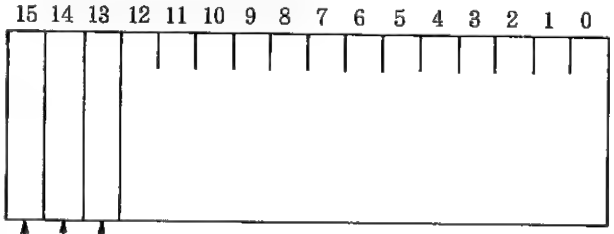


Fig.8-4-3. Interface with the CPU

The drawing circuit receives a 5-word control code from the CPU and sends a 1-word status code to the CPU.
The CPU will know how the previous issued control code was processed by the drawing circuit, by reading the status code that returned against an interrupt request (IRQ) from the drawing circuit. If the drawing circuit was found to be ready for a drawing operation after interrogating the status code, the CPU will let it start by sending the following control code to the drawing circuit.

■ Status code description



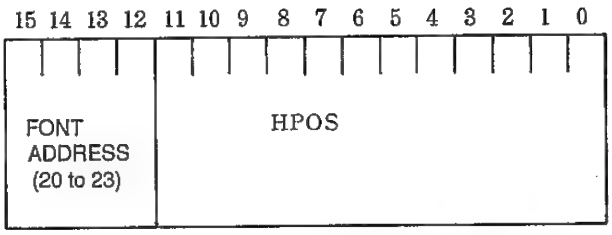
BUSY: Indicates that data transfer is not enabled as the drawing circuit is currently operating.

BUFFER FULL: Indicates that the drawing circuit is not enabled to operation because the ring buffer is fully occupied.

ERROR: Indicates an overrun error that may occur when the data transferred to the print engine exceeded writing the drawing data in the ring buffer within the drawing circuit.

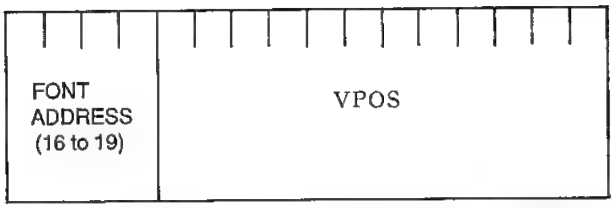
■ Control code description

1)



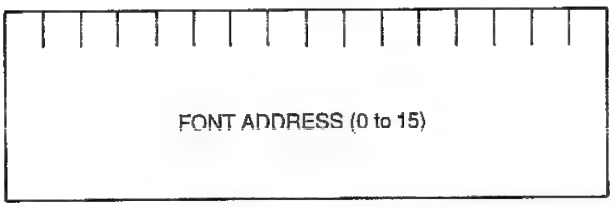
HPOS: Horizontal position on paper (by dots)

2)



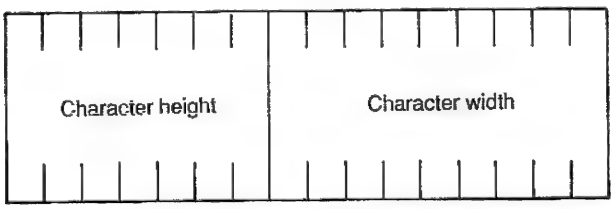
VPOS: Vertical position on paper (by dots)

3)



Font address: Character bit data leading address

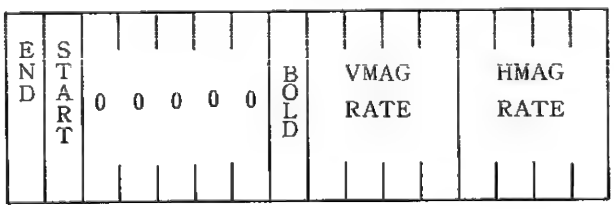
4)



Character height: To be assigned in terms of dot lines.

Character width: To be assigned in terms of bytes

5)



START: Start of drawing

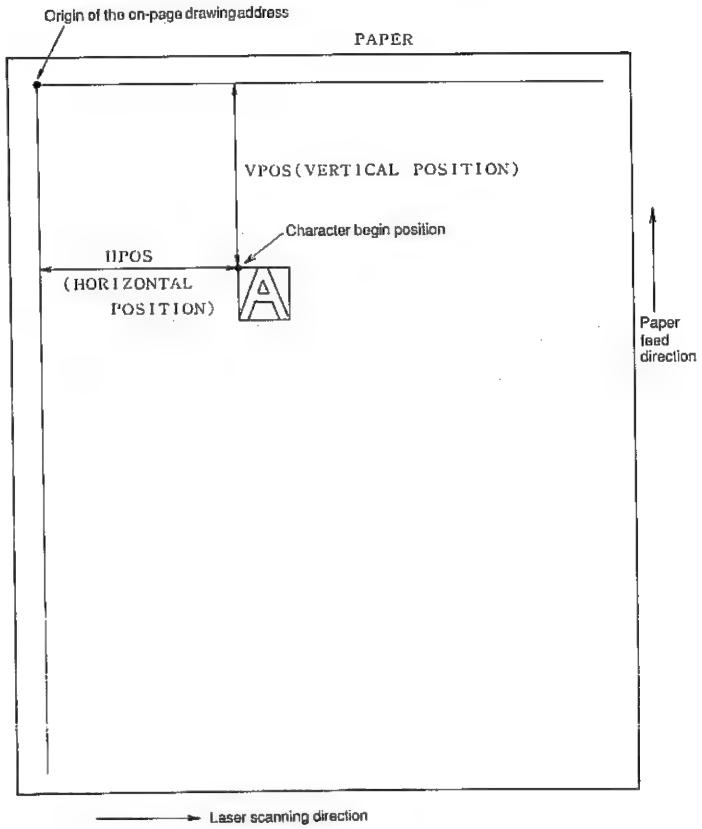
END: Last character of a page

VMAG RATE: To assign vertical magnification or reduction ratio.

HMAG RATE: To assign horizontal magnification or reduction ratio.

BOLD: To assign the character width

■ On-page address by the drawing circuit



1. CPU interfacing signals

(1) Bidirectional data bus (D0 to D15: input/output, pin numbers 109 to 112, 115 to 121, and 123 to 127)
The bidirectional data bus, D0 to D15, is input/output signal lines provided to transfer data between the drawing processor and the processing system that includes the CPU.
D0 to D15 comprises a tri-state buffer which is at a high impedance except when the CPU access the drawing processor internal register.

(2) Address bus (A01 to A23): input/output, pin numbers 1 to 4, 6 to 15, and 18 to 26)
Directly connected with the CPU address bus and is used for the CPU to access the user RAM area.

(3) Read/write (R/$\overline{W}$: input, pin number 31)
The read/write line (R/$\overline{W}$) is an input signal line that is used to control data transfer between the drawing processor and the processing system that includes the CPU. When R/$\overline{W}$ is at a high, data is transferred to the drawing processor and when low the data is transferred from the CPU to the drawing processor.

(4) Chip select ($\overline{CS}$: input, pin number 30)
This line is an input signal line provided for the CPU including processing system to access the drawing processor. When $\overline{IPCS}$ is at a low, the drawing processor internal register can be read and written.

(5) Data transfer acknowledge ($\overline{DTACK}$: output, pin number 29)
$\overline{DTACK}$ is used to inform the end of data transfer. The signal is sent to the CPU by synchronizing -IPCS with the internal clock frequency.

(6) Power-on reset ($\overline{POR}$: input, pin number 38)
Resets all internal states including the clock divider circuitry and goes into the hold state. $\overline{RES}$ must be issued to the operate the drawing processor.

(7) Reset ($\overline{RES}$:, input, pin number 32)
Used to externally reset the internal state of the drawing processor to get it ready for operation. The following condition is established in the drawing processor when a low state of $\overline{RES}$ is received.
After resetting all internal states except for the clock frequency divider and all of 128 x 2560 dots ring buffer is cleared.

NOTES: ■ $\overline{RES}$ must be set low to operate the drawing processor after power on.

■ The contents of registers may not be definite at power on, except for the registers affected after the reset.

(8) Interrupt request (IRQ: output, pin number 28)
The interrupt request signal (IRQ) is an output to inform the end of command to the CPU, detection of an error status, and detection of a buffer full signal. The CPU will therefore be able to know how the previous data has been processed within the drawing circuit.
Though the system that includes the CPU may access the drawing processor while IRQ is at a low, the write data is ignored and the read data may not be established.

2. For the CPU control timing and drawing processor control timing are normally asynchronous, the CPU needs to be synchronous with the drawing processor when the CPU accesses the CG memory.

Upon the time when the address was latched by the CG memory side after the CG memory address was issued by the drawing processor, the CPU read or write the data in synchronization with the drawing processor control clock. That is, $\overline{CGCS}$ is issued to the drawing processor from the CPU. Synchronization is attained at a low to high transition of the fist S4 after $\overline{CGRDY}$ was returned from the drawing processor and read/write is conducted at a rising edge of S5 and falling edge of S6.

NOTE: S4, S5, and S6 is the name given to the CPU control clock.

3. Explaining the sequence that the CPU access the CG memory
① At a high to low transition of the drawing processor clock GO, a row address appears in CGADR0 to 8.

② At a low to high transition of the drawing processor clock G1, $\overline{CGRAS}$ appears.

③ At a high to low transition of the drawing processor clock, a column address appears in CGADR0 to 9.

④ At a low to high transition of the drawing processor clock G3, $\overline{CGCASV}$ and CGCASL are issued.

⑤ When $\overline{CGRDY}$ is issued from the drawing processor, synchronization is achieved at a falling edge of the CPU clock S4 and access starts from the CPU.

⑥ At a falling edge of the CPU clock S4, $\overline{CGOE}$ is issued and the data to be received appears on CD0 to 15, when the CPU is to read the CG memory.

⑦ At a falling edge of the CPU clock S6, the data are read by the CPU.

⑧ At a rising edge of the CPU clock S5, CGOE is issued and the write data are written in the CG memory, when the CPU is to write the CG memory.

* CGADR18 to 22 are retained during a memory cycle.

Explaining the sequence the CPU accesses the CG memory

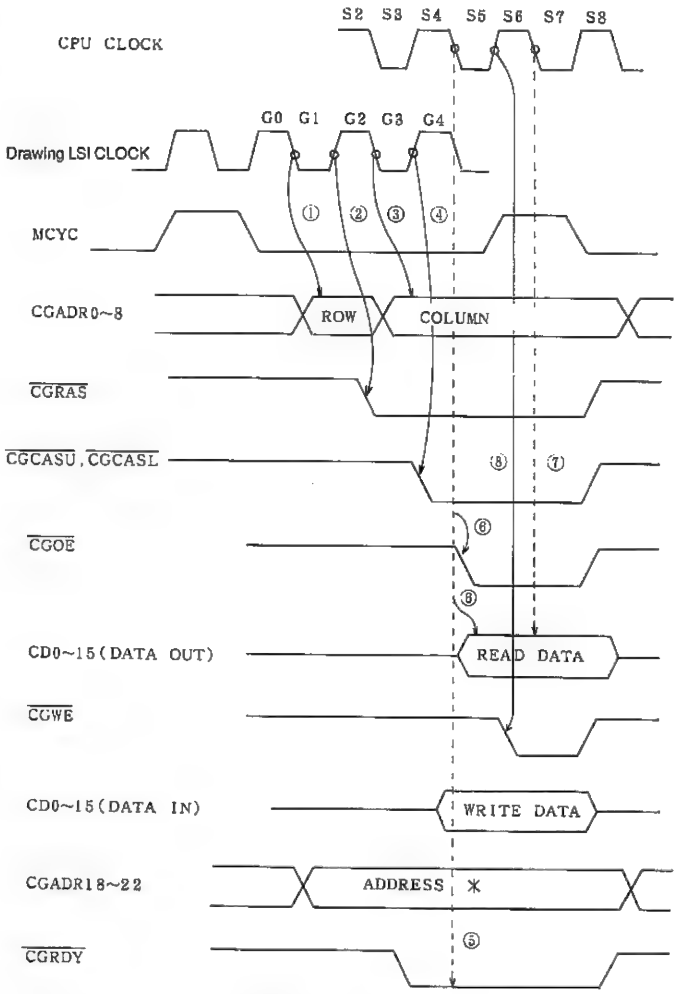


Fig.8-4-4. Timings

8-4-2. CG memory interface

The drawing circuit within the drawing processor will directly access the CG memory as shown below. Address bus and control signals to the CG memory are issued from the DRAM controller. When the drawing circuit reads the CG memory, the CPU data bus is not connected as seen from the drawing circuit, because the CG data bus side port of the bidirectional bus driver is high impedance by $\overline{OBTEN}$.

The CG memory consists of the following buses:

Address bus (CGA00 to CGA23)

Data bus (CGD00 to CGD15)

Control signals ...

$\overline{CGCS}$, $\overline{CRFSH}$, $\overline{CGRAS}$, $\overline{CGOE}$, $\overline{CGRDY}$, $\overline{OBTEN}$, $\overline{CGCAS}$,-$\overline{CGWE}$

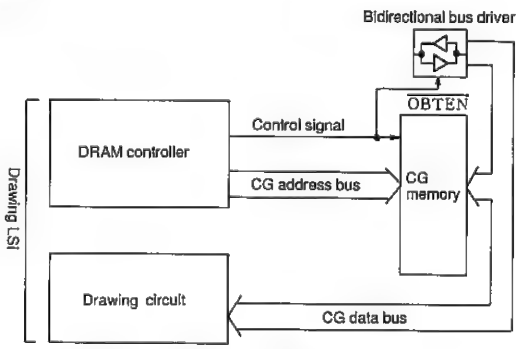


Fig.8-4-5. Interface with the CG memory

1. CG memory interfacing signals

(1) CG address (CGA00 to CGA23)
CG memory address signal which transferred the address designated by the drawing circuit, address designated by the CPU, and the refresh addressed multiplexed altogether. Those select signals are issued by $\overline{CGCS}$ and internal select signal.
The high and low order addresses are sent out in synchronization with $\overline{CGRAS}$ and $\overline{CGCAS}$.

(2) CG data (CGD00 to CGD15)
The data in the CG memory are synchronization with $\overline{CGOE}$ according to the CG address.

(3) $\overline{CGCS}$, input pin number 34
This signal is used by the CPU to access the CG memory which the memory access is judged at the first state of memory cycle (MCYC). If a RAM select signal has been issued to make drawing internally ($\overline{DRAW}$ at a low), the execution is done at a cycle next to the memory cycle.

(4) $\overline{CGRDY}$, output pin number 39
ACK signal which indicates that -CGCS has been accepted during the memory cycle.

(5) $\overline{CRFSH}$, output pin number 35
Used to refresh the CG memory.

(6) $\overline{OBTEN}$, output pin number 33
A bidirectional bus buffer enable signal sends the CG memory data on the CPU data bus in response to the CG memory access command from the CPU or sends the CPU data on the drawing processor.

(7) CG memory control signals

$\overline{CGRAS}$: Output pin number 36

$\overline{CGCAS}$: Output pin number 37

$\overline{CGOE}$: Output pin number 40

$\overline{CGWE}$: Output pin number 41

Those signals are connected to $\overline{RAS}$, $\overline{CAS}$, $\overline{OE}$, $\overline{WE}$ of the CG memory.

2. Explaining the sequence that the drawing processor uses to read the CG memory

① $\overline{DRAW}$ is at a low state in the cycle that the drawing processor access the drawing.

② A row and column address is sent on CGADR0 to 8 in synchronization with $\overline{CGRAS}$ and $\overline{CGCAS}$. When accessing the ROM, the low order address is latched in the external IC by $\overline{CGRAS}$.

③ The RAM data dependent to $\overline{CGRAS}$ and CGCAS is sent onto CGDATA00 to 15 by $\overline{CGOE}$.

** CGADR18 to 23 is retained during the drawing access cycle.

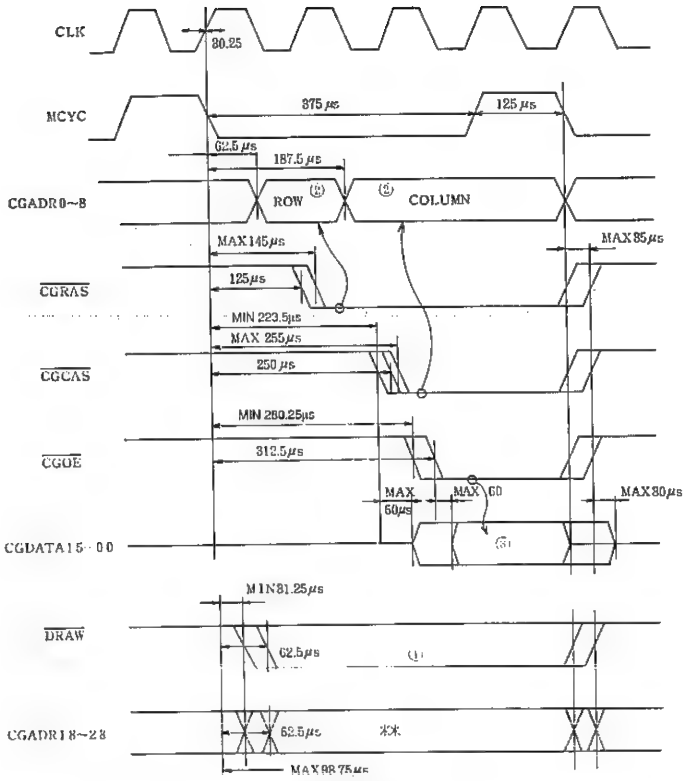


Fig.8-4-6. Timings

* Drawing access cycle: Indicates the period that the drawing processor access the CG memory. $\overline{DRAW}$ is at a low level during this cycle.

8-4-3. Ring buffer interface

The ring buffer is a video memory that consists of 2560 x 128 dots and is directly connected to the drawing processor. The ring buffer can be read and written in synchronization with a signal from the drawing circuit.

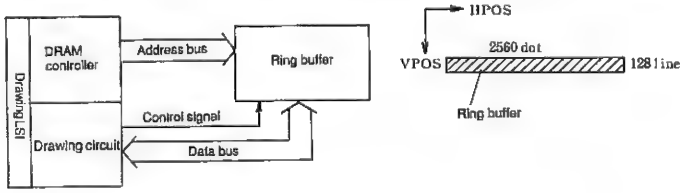


Fig.8-4-7. Interfacing with the ring buffer

The ring buffer interface consists of the following buses:

Address bus (T0 to T7)

Data bus (RD0 to RD7)

Control signal ($\overline{RRAS}$, $\overline{RCAS}$, $\overline{ROE}$, $\overline{RWE}$)

1. Interfacing signals with the ring buffer

(1) Memory cycle (MCYC: output, pin number 27)
Memory cycle signal is an output that indicates access cycle to the user RAM and ring buffer by the drawing processor.

(2) OBTEN ($\overline{OBTEN}$: output, pin number 33)
An output signal that controls the data transfer between the CPU and the memory, when the CPU read/write the memory. The drawing processor cannot accept memory read/write by the CPU while the internal drawing circuit is in operation (DRAW at a low level), but the memory data can be sent on the data bus by OBTEN when DRAW is at a high.

(3) Draw ($\overline{DRAW}$, output, pin number 42)
The signal $\overline{DRAW}$ is an output signal that indicates whether the drawing processor is in the drawing accessing cycle or CPU accessing cycle.
With a low state of $\overline{DRAW}$, the drawing processor is in the drawing accessing cycle so that CGA is sent on the drawing address.

NOTE: $\overline{DRAW}$ can be at a low level only when the drawing processor is in the drawing accessing cycle.

(4) Ring buffer data (RD00 to RD07)
Ring buffer data is in the 8-bit structure and is in the state that the CG data was processed by the drawing processor (after the word to byte conversion, enlarge, or reduce).

(5) Ring buffer address (RA00 to RA07)
Directly connected with the ring buffer address bus and is used to access the ring buffer by the drawing circuit.

(6) Ring buffer control signals

$\overline{RRAS}$: Output, pin number 98, RAS signal connected to the ring buffer

$\overline{RCAS}$: Output, pin number 99, CAS signal connected to the ring buffer

$\overline{ROE}$: Output, pin number 100, read signal to the ring buffer.

$\overline{RWE}$: Output, pin number 97, write signal to the ring buffer

2. Explaining the sequence that the drawing processor accesses the ring buffer

① At a low to high transition of R0 of CLK (16MHz), row address is sent on T0 to T7.

② At a low to high transition of R2 of CLK (16MHz), $\overline{RRAS}$ is issued.

③ At a low to high transition of R3 of CLK (16MHz), column address is sent on T0 to T7.

④ At a low to high transition of R4 of CLK (16MHz), $\overline{RCAS}$ and $\overline{ROE}$ are issued.

⑤ Data to be read is sent on P0 to P7, when -$\overline{RCAS}$ is issued, for the drawing processor to read the contents of R6 of the ring buffer.

⑥ Data is sent to the drawing processor at a low to high transition of R6 of CLK (16MHz).

⑦ Write data is sent on P0 to P7, when $\overline{RCAS}$ is issued, for the drawing processor to write data in the ring buffer.

⑧ $\overline{RWE}$ is issued at a low to high transition of the clock R6 (16MHz) to write data in the ring buffer at a rising edge of R8.

Ring buffer timing (read and modify write)

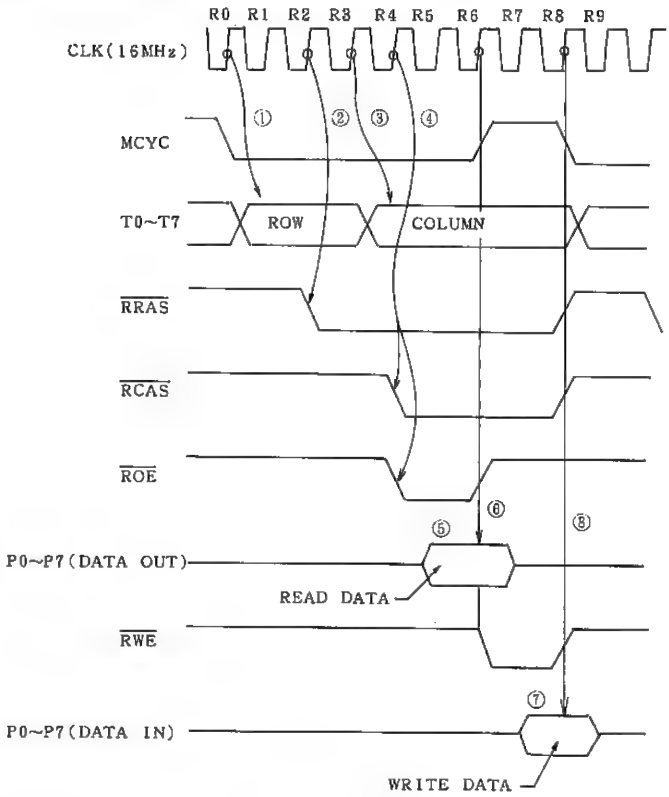


Fig.8-4-8. Timings

8-4-4. Printer interface signals

(1) $\overline{PAGE}$: Output, Pin No. 105

This signal is to ask the PCU to start printing, and is kept LOW while one-page data is transmitted.

When the PCU receives this signal, it starts the printing operation (if there is no error.)

(2) $\overline{CLK}$: Input, Pin No. 106

This is a clock signal synchronizing for every one dot (one video data), sent from the PCU. The drawing circuit is synchronized with this clock signal to transmit video data to the printer engine.

(3) $\overline{HSYNC}$: Input, Pin No. 107

This is a synchronizing signal for every one line, sent from the PCU. In synchronization with this signal, video data are transmitted for every one line.

(4) PDATA:

Output, Pin No. 101

Video data to be transmitted to the PCU.

8-5. Timer (8253)

The 8253 timer has three channels of the timer counter; each one of these channels has the following usage.

(1) Channel 0 operates in Mode 3 (rate generation mode) which is used to set the RS232C serial data transmission baud rate. Baud rate is created after dividing an input clock of 614.4KHz.

(2) Channel 1 operates in Mode 0 (count complete interrupt mode) which is used for an interval timer interrupt at every 6ms.

(3) Channel 2 operates in Mode 1 (rate generation mode) which is used for counting of the PCU interface sync clock. Sync clock from the PCU is divided by scan width and issued to T2. The signal is sent on T2 and controls the sync clock count enable flip-flop.

* Rate generation mode:
  Clock is obtained by dividing the input clock whose dividing factor is assigned by a command from the CPU.
* Counter complete interrupt mode:
  By counting down the basic clock from the counters' default value, an interrupt is caused when the counter value becomes 0.

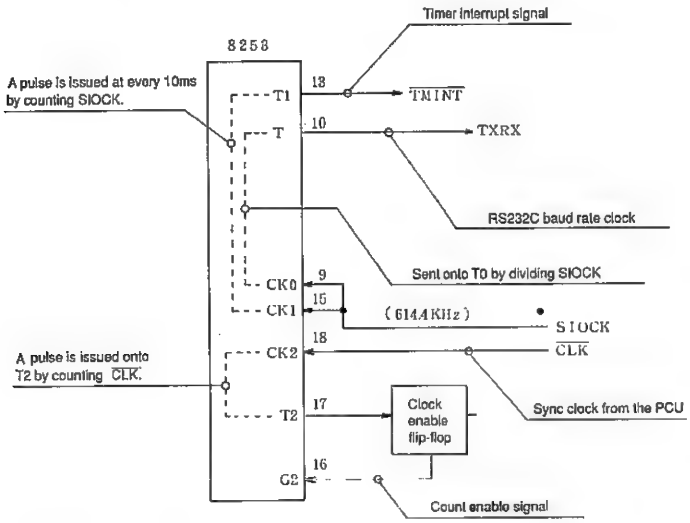


Fig.8-5. Timer

8-6. Centronics interface

8-6-1. General

The Centronics interface is provided for interface with an external host device. The interface circuitry consists of an 8255 general I/O device. Port A of the 8255 is assigned to the data bus input port from the host. Port B of the 8255 is assigned to the output port for transfer of control signal to the host. Port C is assigned to the input port, except for PC3 and PC5 which is used for control signal port from the host. The data bus lines on the CPU side are directly connected to the CPU data bus to allow direct accessing by the CPU.

8-6-2. Circuit description

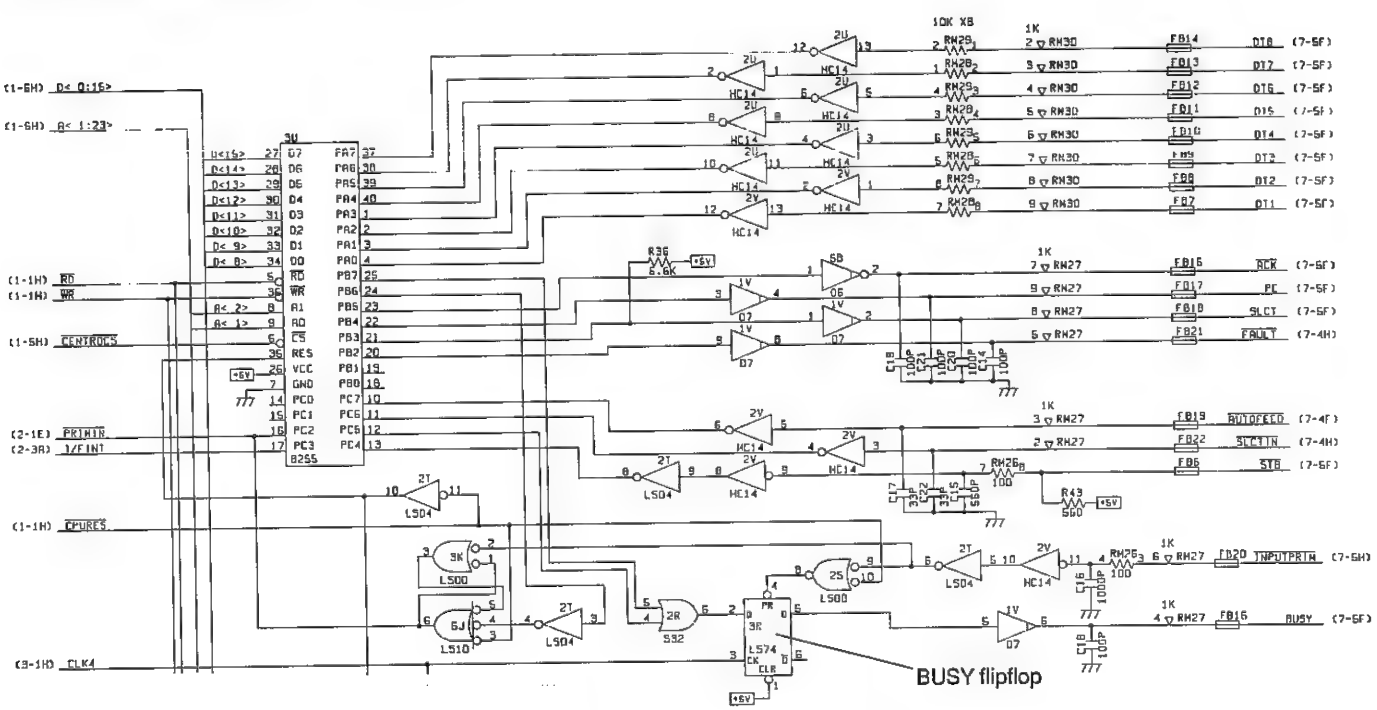


Fig.8-6-1. Centronics interface circuit

8-6-3. Signal description

(a) $\overline{STB}$ (input, low active)
Sync signal used to read data.

(b) DATA1 to DATA8 (input)
Represents information from the first to eight bits.

(c) $\overline{ACK}$ (input, active low)
Acknowledge to $\overline{STB}$ input which is received when data input is terminated.
This signal is also issued when BUSY turns from high to low during initialization.

(d) BUSY (active high, output)
Indicates that data input is not enabled.
This signal is issued in one of the following:

(i) During processing of the receive data

(ii) During initialization

(iii) During alarm

(iv) When the buffer is full.

(e) PE (output, active high)
This signal is issued when a paper empty exists.

(f) SELECT (output, active high)
High when in the on-line mode and low in the off-line mode.
On-line mode is established in one of the following.

(i) Upon completion of initialization

(ii) When the ONLINE switch is pressed in the off-line mode.

NOTE: On-line mode would not be established in the alarm mode for the above (i) and (ii).

On-line mode is established in one of the following.

(i) When the ONLINE switch pressed in the off-line mode.

(ii) When in the alarm.

(g) $\overline{INPUTPRIM}$ (input, active low)
It goes into the initialization mode when this signal is received.

(h) $\overline{FAULT}$ (output, active low)
This signal is issued when in the alarm mode.
It goes into the off-line mode when this signal is issued.

8-6-4. Data receiving flow

Explanation of the Centronics interface data receive flow

① The host sets up DATA8 to DATA1 and asserts -STB.

② At a leading edge of STB, BUSY is returned to the host.

③ At a trailing edge of $\overline{STB}$, the interrupt signal $\overline{IFINT}$ is asserted to inform the CPU that there was a data reception.

④ At a trailing edge of $\overline{STB}$, data is latched in the data receive latch.

⑤ Awaits with $\overline{IFINT}$ until the CPU recognizes it.

⑥ As the CPU recognizes the interrupt, -IFINT is negated and the data is read in the receive latch.

⑦ At the moment it became enabled to receive the next data, -ACK is asserted to request the next data.

⑧ After negating $\overline{ACK}$, BUSY is negated and a single byte receive sequence terminates.

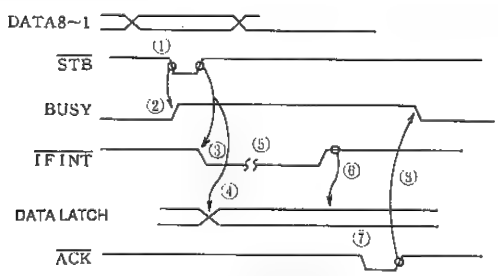
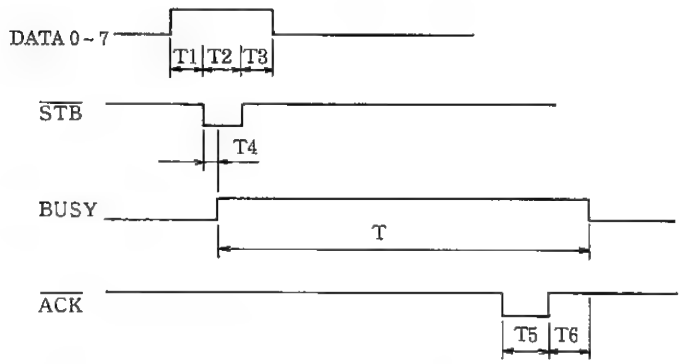


Fig.8-6-2. Receiving flow

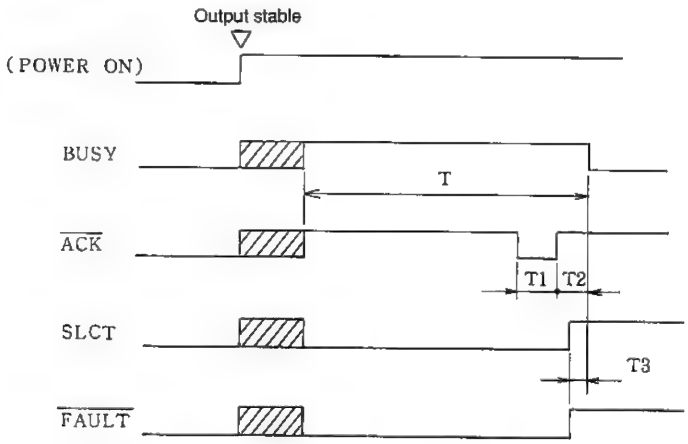
8-6-5. Centronics interface timings

a) Data receive (Centronics 703)



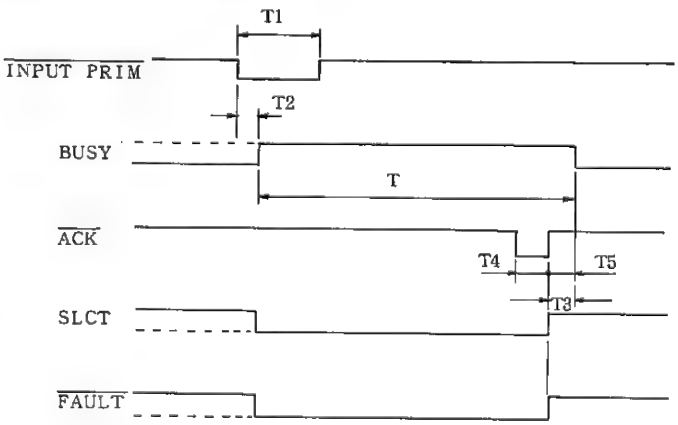
T1: 0.5 microsecond, min.
T2: 0.5 microsecond, min.
T3: 0.5 microsecond, min.
T4: 1.0 microsecond, max.
T5: 10.0 microseconds, min.
T6: 25.0 microseconds, max.

b) At power on



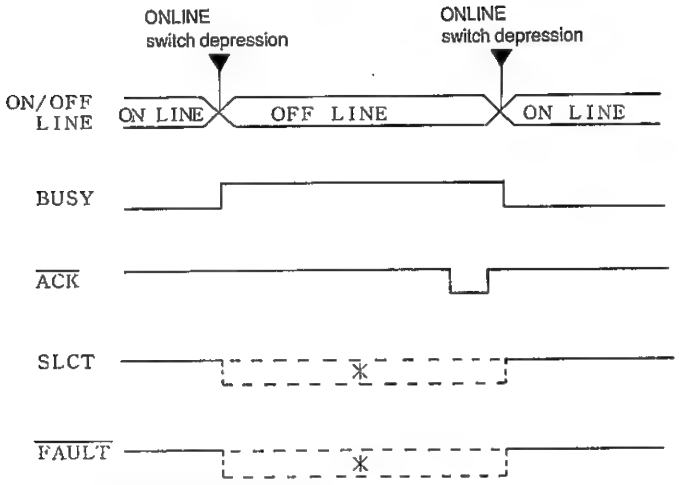
T1: 10 microseconds, min.
T2: 25.0 microseconds, max.
T3: 0, min.
T: Initializing time

c) When $\overline{INPUT\ PRIME}$



T1: (MIN)
T2: (MAX)
T3: 0 (MIN)
T4: 10μs (MIN)
T5: 0, min.
T: Initializing time

d) ON LINE/OFF LINE selection



* May differ depending on emulation.

Fig.8-6-3. Centronics interface timing

8-7. RS232C interface

8-7-1. Specifications

Communication: Start/stop mode ...Asynchronous

Baud rate: 300, 600, 1200, 2400, 4800, 9600, 19200 bps

Transmission: Full duplex

Synchronization: Start bit ...1
Stop bits ...1 or 2
Data bits ...7 or 8
Internal clock synchronization

Error detection: Even or odd parity check

8-7-2. Interfacing signals

The interface connector signal table and the connector for RS232C interface is shown in Table 8-7.

Table 8.7 RS232C Signal

NO.	SIGNAL
1	GND (Signal Ground)
2	$\overline{\text{TXD}}$ (Transmitted Data)
3	$\overline{\text{RXD}}$ (Received Data)
4	RTS (Request to Send)
6	DSR (Data Set Ready)
14	FG (Frame Ground)
20	DTR (Data Terminal Ready)

Outline View of Interface Connector

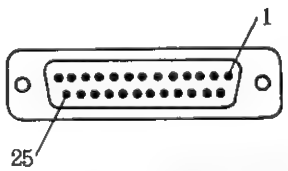


Fig. 8.7.1 DDK 17LE2528 (device side)

8-7-3. Description of RS232C interface signals

(1) $\overline{\text{TXD}}$
Data transferred to external equipment

(2) $\overline{\text{RXD}}$
Data receive by the laser printer

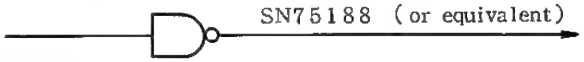
(3) RTS
This signal is issued by the laser printer when it is ready to send data.

(4) DSR
This signal indicates if the external equipment is ready or not.

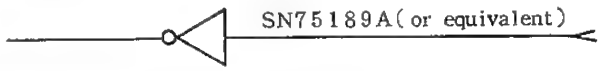
(5) DTR
This signal indicates if the laser printer is ready or not.

8-7-4. Signal levels at RS232C interface

Signals : $\overline{\text{TXD}}$, DTR, RTS



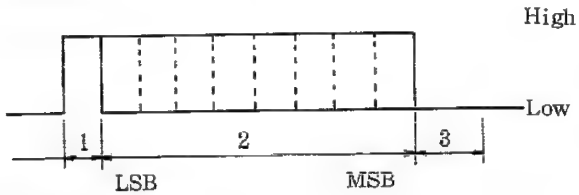
Signals : $\overline{\text{RXD}}$, DSR



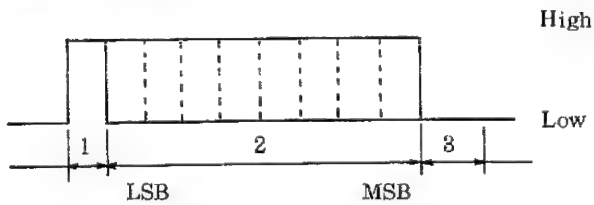
Receive signal level: High ...+3 to +15V
Low ... −15 to −3V

Transmit signal level: High ...+3 to +15V
Low ...−15 to −5V

Transmit data: $\overline{\text{TXD}}$



Receive data: $\overline{\text{RXD}}$



1. Start bit
2. 1-byte data
3. Stop bit(s)

8-7-5. Serial interface handshake

(1) XON/XOFF handshake
This mode can be set on the operation panel keyboard.
In this handshake mode, the laser printer, when busy, sends an XOFF code to request the host to halt data transmission. The printer, when not busy, sends an XON code to prompt the host to restart data transmission.

(2) ETX/ACK handshake
This mode can be set on the operation panel keyboard.
In this handshake mode, data is transmitted block by block and each data block transmission is concluded with an $\overline{\text{ETX}}$ code.
The laser printer becomes busy when it receives an ETX code, and the host cannot send a new data block until the printer sends an ACK code.

(3) DTR handshake
This mode can be set on the operation panel keyboard.
The laser printer is busy when its output line DTR is at a low, and cannot receive data.
When the DTR line is at a high, the printer is not busy and can receive data.

8-7-6. RS232C interface parameters settings

Parameters for the RS232C interface can be set on the operation panel keyboard.

The following describes the parameters:

(1) Baud rate

(2) Data length

(3) Parity check

(4) Stop bit(s)

(5) ETX/ACK handshake mode

(6) XON/XOFF handshake mode

(7) DTR handshake mode

8-7-7. Circuit description

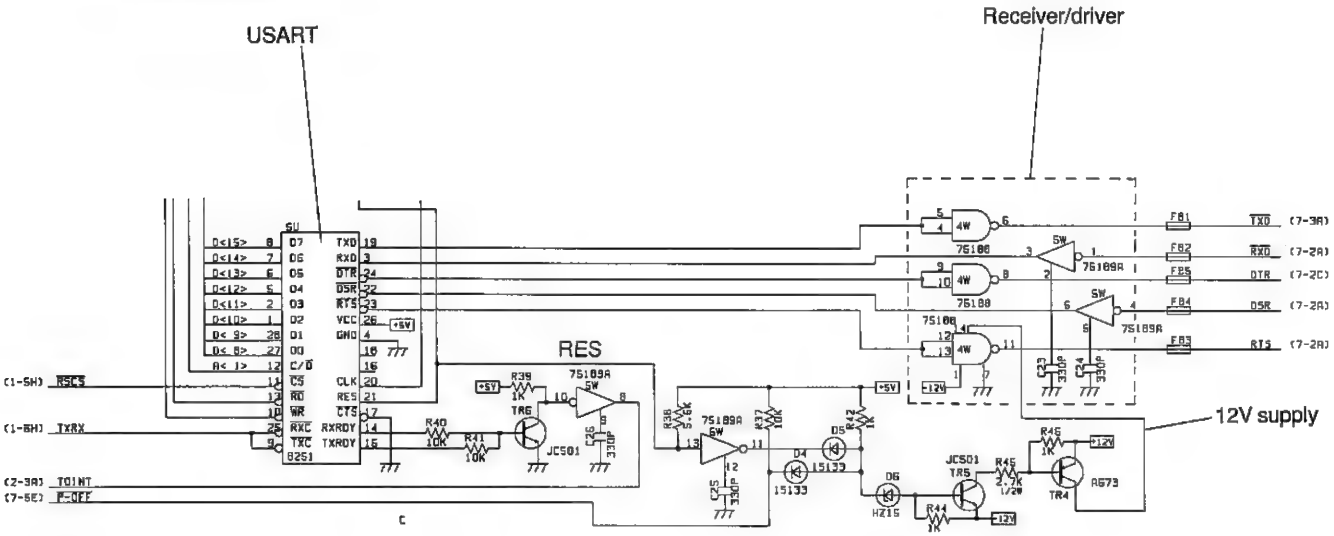


Fig.8-7-3. RS232C interface circuit

RES:

It is possible at power on that the driver (75188) may malfunction because 5V supply may rise before 12V. To prevent this, the 12V supply is restricted with RES.

USART: Universal Synchronous/Asynchronous Receiver/Transmitter

9. Basic software configuration

9-1. General

Software interprets the coded data received from the host to create drawing database. Printing can take place upon completion of preparing the drawing data of a page.

The main routine consists of the following:

① Initial task

② Format task

③ Print task

General flow of the main routine is shown in Fig.9-1-1.

Table 9-1-1 shows the major functions of main routine tasks.

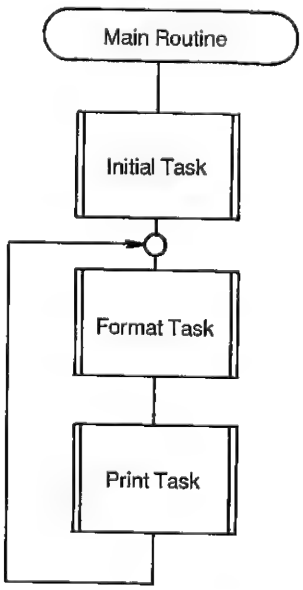


Fig. 9-1-1 General Flow

	Major functions
Initial Task	Resets flags and I/O port at power on.
Format Task	Interprets the input data and creates the database.
Print Task	Starts printing upon completion of creating a pageful database.

Table 9-1-1. Main routine functional description

9-2. Explaining routines

9-2-1. Initial task

The following describes the major functions.

① Work RAM area initialization
② I/O port initialization
③ Memory check
④ Program routine initializations
⑤ Italic, elite, and other fonts creations

9-2-2. Format task

The following describes the major functions.

① Reads data from the input buffer.
② The data is interpreted based on the emulation to create a 5-word drawing database.
③ The drawing database is stored in the RAM.
The input buffer is a memory area which temporarily stores the input data before the data is interpreted.

9-2-3. Print task

Upon the completion of creating a page drawing database, the printer is started. Data transfer from the user RAM area to the drawing circuit is done by means of an interrupt by the drawing circuit.

9-2-4. Others

The following are provided as a handler and interrupt routine.

1. Handler
① RS232C interface handler
② Centronics interface handler
The above two store the data received from the host in the input buffer.
③ NVRAM handler
The data is stored and retained even if the power is turned off.
④ PCU interface handler
By monitoring the state of the print engine, control signal required to print control is sent.

PCU: Process Control Unit

2. Interrupt
① NMI routine
Interrupt is issued when the power is turned off and the data is saved in the NVRAM.
② HSYNC interrupt
Used to interrupt data transfer sync to the print engine. A video signal is sent to the print engine at every line.
③ TMI interrupt
Interrupt from the interval timer which is used as a soft timer basic clock.
④ IRQ interrupt
Drawing database is written in the drawing circuit when a drawing interrupt is received.
⑤ PCU interrupt
Used to judge the engine errors (D0, PJ, etc.) or display the key interruption and perform the internal process when the interrupt signal from the printer engine is received.
⑥ Interface interrupt
Interrupt from the Centronics or RS232C interface which is used to inform that data has been received. In this timing, the CPU begins to read the received data.

9-3. Drawing database

9-3-1. Download font, internal font, cartridge font

As shown, a drawing database of one character consists of five words.

Font No.			
Link Address			
HMAG		HPOS	
VMAG		VPOS	
DIVIDE		BOLD	CATA (RELATIVE)

Font number: Used to specify kind of fonts used. Those represented by ID number in the font list are used. It can be chosen from 00 to 6F, hex.

Link address: Used to connect the present database with a next database and contains the address of the database to be printed next.

HPOS, VPOS: Indicates the absolute location mapped on the paper under the resolution of 300 dpi (in terms of dots).

HMAG: Represents the horizontal enlarge/reduce.

VMAG: Represents the vertical enlarge/reduce.

Parameter

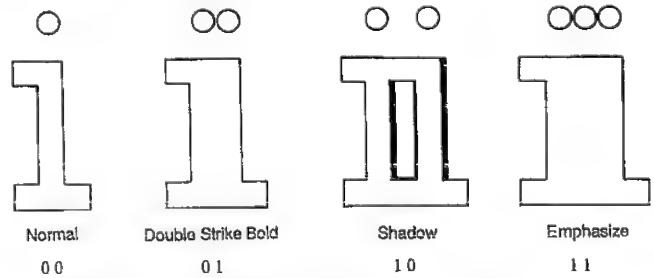
Magnification ratio	1/2	1/1	2/1	3/1
HMAG	08H	00H	01H	02H

Parameter

Magnification ratio	1/2	1/1	2/1	3/1	4/1
VMAG	08H	00H	01H	02H	03H

Bold: Specifies the character width.

	Normal	Double Strike bold	Shadow	Empha size
Bold	00H	01H	10H	11H

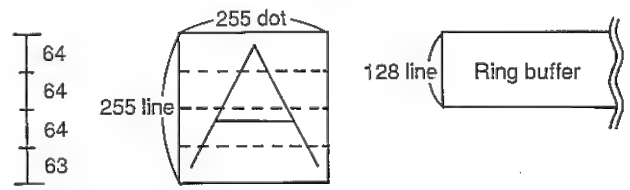


Any character can be enlarged, reduced, or boldfaced to print.

CATA (absolute): Indicates the top address of the character access table where contained character fonts assigned by the font number.

DIVIDE: A large character is divided so as to be written into the ring buffer, and the numbe of division of the character is specified. The output to the ring buffer is max. 64 lines. In the example below, the number of division is "DIVIDE 04".

Example: Max. font of HPLJ+



9-3-2. Bit image

Font No.	
Link Address	
HMAG	HPOS
VMAG	VPOS
V-Volume	H-Volume
Bit image data	

A bit image drawing database consists of five words plus n-words as shown above.

Font number: In the case of a bit image, the front number is fixed to DF hex.

Link address: database and contains the address of the database to be printed next.

HPOS, VPOS; Indicates the bit image starting absolute location mapped on the paper

under the resolution of 300 dpi (in terms of dots).

V-volume, H-volume: Represents the size of a big image in the vertical and horizontal directions.

HMAG: Represents horizontal enlarge.

VMAG: Represents vertical enlarge.

Image enlarge parameter

	300dpi	150dpi	100dpi	75dpi
HMAG	00(H)	01(H)	02(H)	03(H)
VMAG	00(H)	01(H)	02(H)	03(H)

300dpi 150dpi 100dpi 75dpi

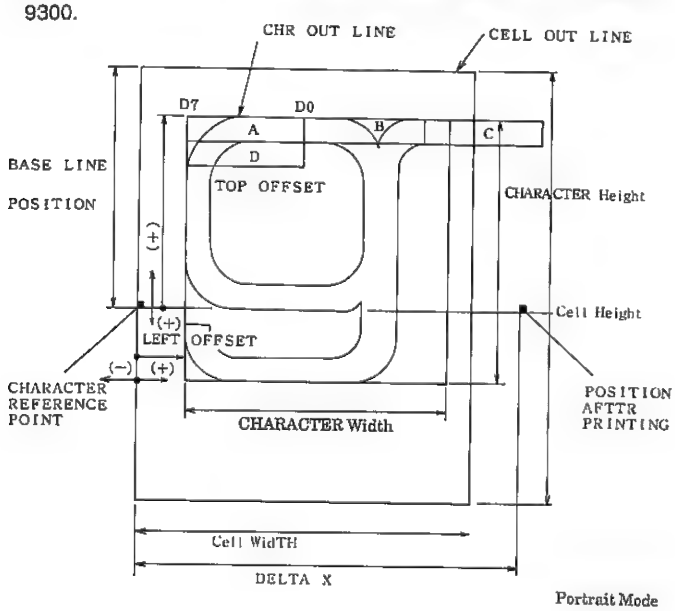
9-4. Definition of font

There are three kinds of fonts; internal, soft, and cartridge fonts.

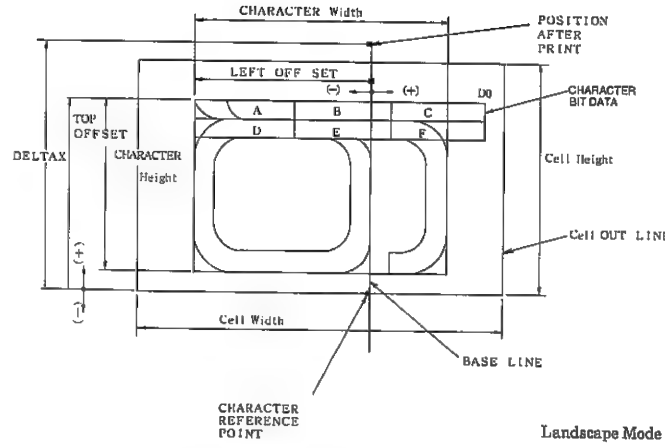
The internal font may be contained within the ROM area or automatically stored in the user RAM area at power on.

9-4-1. Character configuration

All characters are in the CG cell based on the reference point. This format is common to all emulation modes supported by the JX-9300.



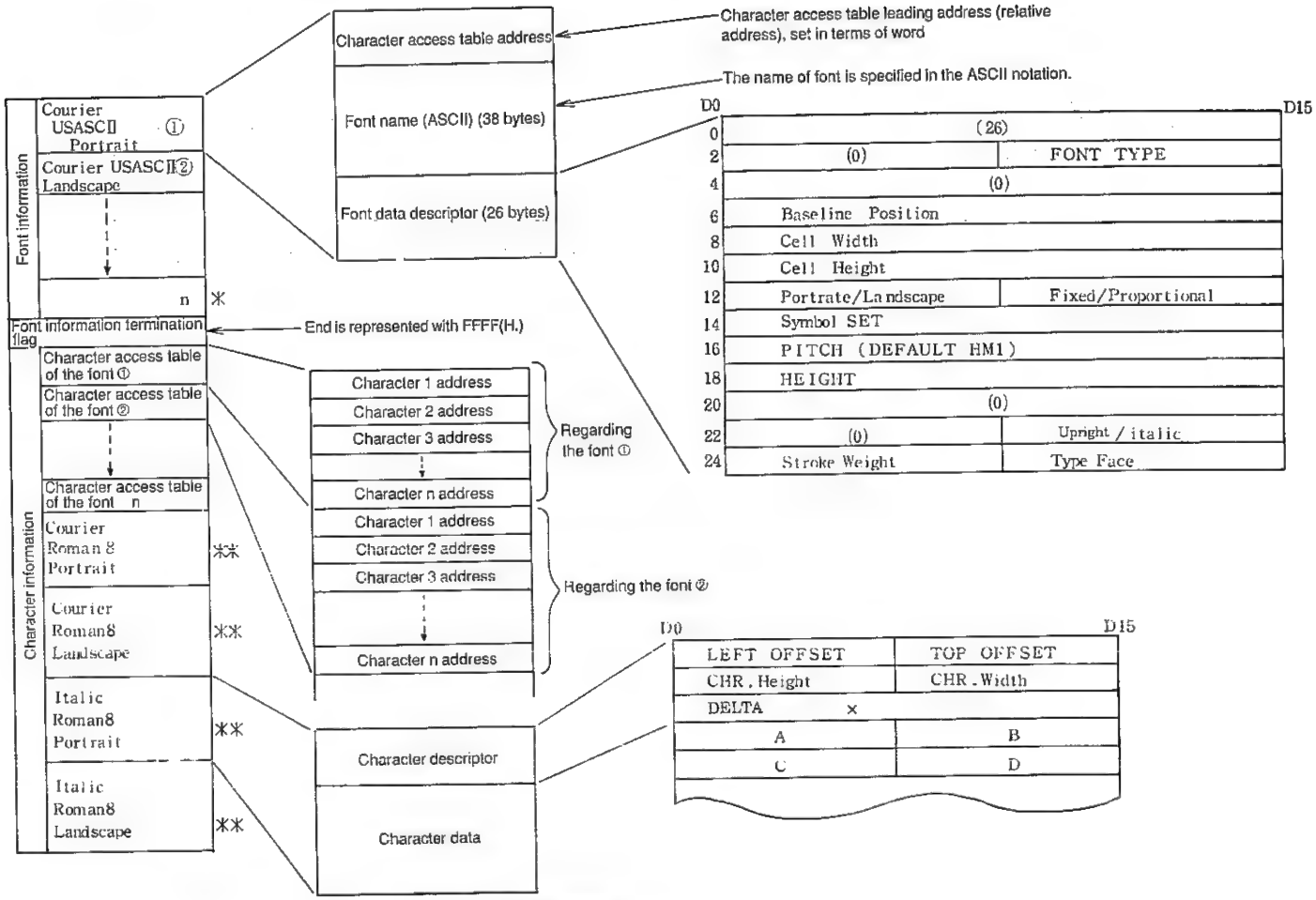
Portrait Mode



Landscape Mode

9-4-2. Internal font configuration

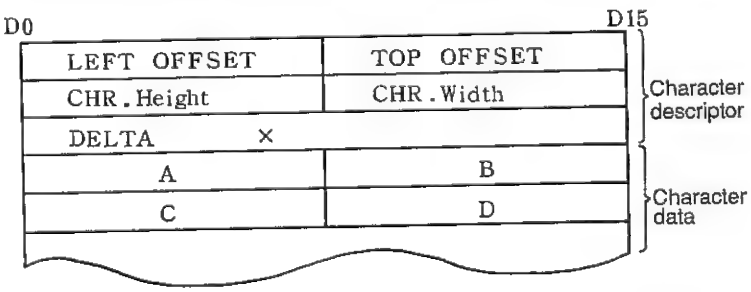
9-4-2-1. Internal font on the CGROM



*: In regard to "n" number, it represents all kinds listed in the font list.
**: Internal fonts that incorporates character data are these four kinds.

Basically, font information and character information are stored in the CG ROM.
Covering all fonts listed in the font list, information for ① character access table address (lading address where character access table is stored), ② name of font, and ③ font descriptor are stored regarding (i) courier USASCII portrait, (ii) courier USASCII landscape, and (iii) courier Roman8 portrait.
Character information contains the address code where characters are stored in a particular font, each font followed by the character descriptor and the character data.

See below for the relationship of the character descriptor and character data vs. print pattern.



9-4-2-2. Internal font on user RAM

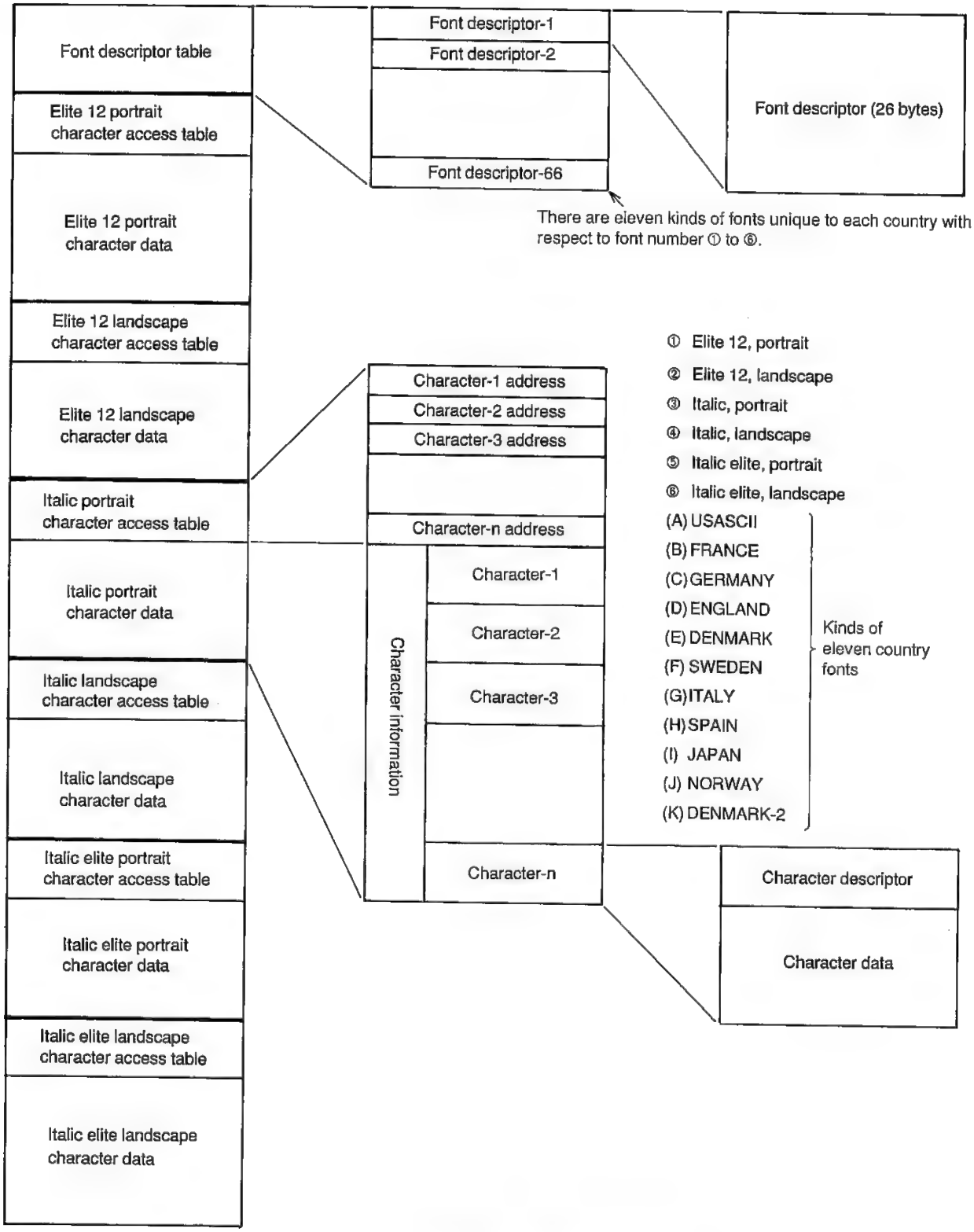


Fig. 9-4-3. Internal font configuration (on RAM)

9-4-3. Download font configuration (on user RAM)

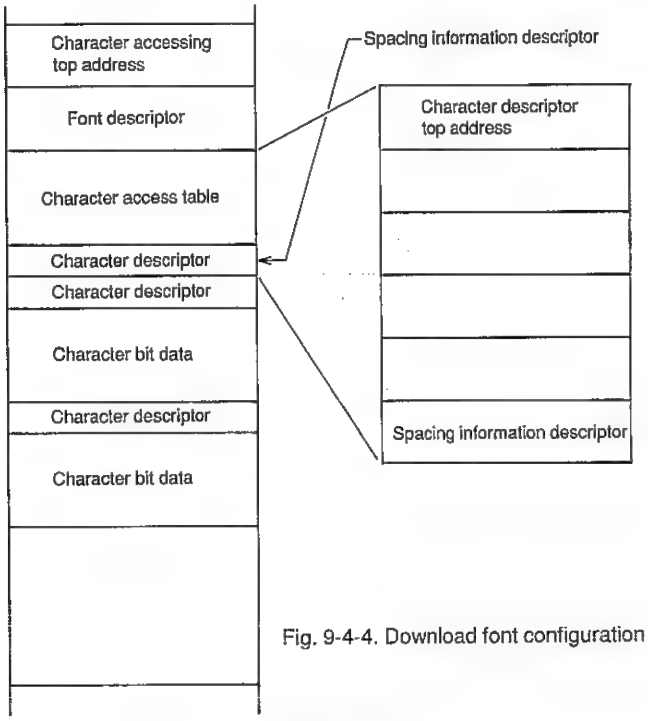
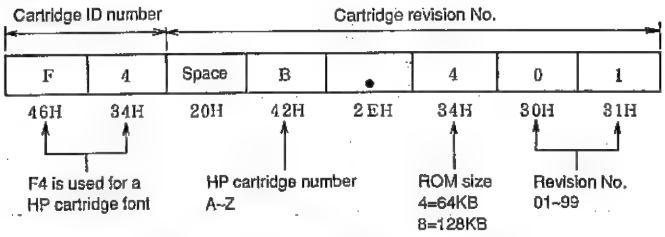


Fig. 9-4-4. Download font configuration

■ Cartridge font information

The cartridge font information is contained from the address FF00 hex.



Those must be ASCII code assigned by a hexadecimal number.

Sumcheck data

1. For the 64KB cartridge
   Data between 0000H and FFFEH added in terms of byte is stored in FFFFH.
2. For the 128KB cartridge
   Data between 0000H and 1FFFEH added in terms of byte is stored in 1FFFFH.

The block structure of a 128KB cartridge is same as the 64KB cartridge.

9-4-4. Cartridge font configuration

■ Kinds (for emulation only)

1. IBM drawing printer and IBM proprinter
2. Hewlett Packard LaserJet+
3. Diablo 630
4. Diablo 630 ECS
   Two kinds are available: 64KB or 128KB.
   The following shows the configuration.

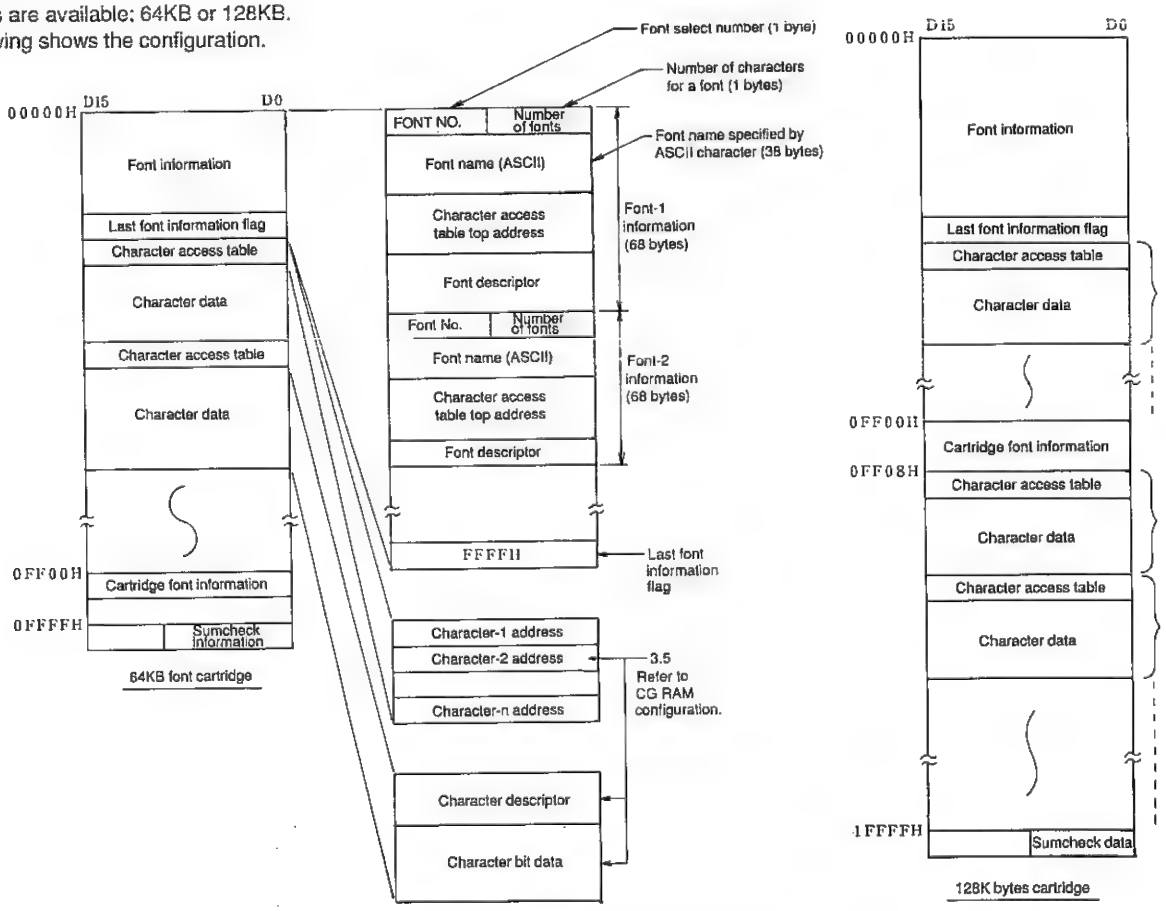


Fig.9-4-5. Cartridge font configuration

9-4-5. Font list

ID	HP	D630	FX80	IBM
00	COURIER USASCII-P	COURIER U.S.A.-P	UPRIGHT U.S.A.-P	COURIERUSASCII-P
01	COURIER USASCII-L	FRANCE-P	FRANCE-P	COURIER USASCII-L
02	COURIER ROMAN-8-P	GERMANY-P	GERMANY-P	— CARD FONT —
03	COURIER ROMAN-8-L	ENGLAND-P	ENGLAND-P	
04	COURIER ROMAN-EXT-P	DENMARK-P	DENMARK-P	
05	COURIER ROMAN-EXT-L	SWEDEN-P	SWEDEN-P	
06	L.PRINTER USASCII-P	ITALY-P	ITALY-P	
07	L.PRINTER USASCII-L	SPAIN-P	SPAIN-P	
08	L.PRINTER ROMAN-8-P	JAPAN-P	JAPAN-P	
09	L.PRINTER ROMAN-8-L	NORWAY-P	NORWAY-P	
0A	L.PRINTER ROMAN-EX-P	DENMARK2-P	DENMARK2-P	
0B	L.PRINTER ROMAN-EX-L	COURIER U.S.A.-L	UPRIGHT U.S.A.-L	
0C		FRANCE-L	FRANCE-L	
0D		GERMANY-L	GERMANY-L	
0E		ENGLAND-L	ENGLAND-L	
0F		DENMARK-L	DENMARK-L	
10	— CARD FONT —	SWEDEN-L	SWEDEN-L	
11		ITALY-L	ITALY-L	
12		SPAIN-L	SPAIN-L	
13		JAPAN-L	JAPAN-L	
14		NORWAY-L	NORWAY-L	
15		DENMARK2-L	DENMARK2-L	
16		— CARD FONT —	ITALIC U.S.A.-P	
17			FRANCE-P	
18			GERMANY-P	
19			ENGLAND-P	
1A			DENMARK-P	
1B			SWEDEN-P	
1C			ITALY-P	
1D			SPAIN-P	
1E			JAPAN-P	
1F			NORWAY-P	
20			DENMARK2-P	
21			ITALIC U.S.A.-L	
22			FRANCE-L	
23			GERMANY-L	
24			ENGLAND-L	
25			DENMARK-L	
26			SWEDEN-L	
27			ITALY-L	
28			SPAIN-L	
29			JAPAN-L	
2A			NORWAY-L	
2B			DENMARK2-L	
2C			ELITE 12 U.S.A.-P	
2D			(UPRIGHT) FRANCE-P	
2E			GERMANY-P	
2F			ENGLAND-P	
30			DENMARK-P	
31			SWEDEN-P	
32			ITALY-P	
33			SPAIN-P	
34			JAPAN-P	
35			NORWAY-P	
36			DENMARK2-P	
37			ELITE 12 U.S.A.-L	
38			(UPRIGHT) FRANCE-L	
39			GERMANY-L	
3A			ENGLAND-L	
3B			DENMARK-L	
3C			SWEDEN-L	
3D			ITALY-L	
3E			SPAIN-L	
3F			JAPAN-L	
40			NORWAY-L	

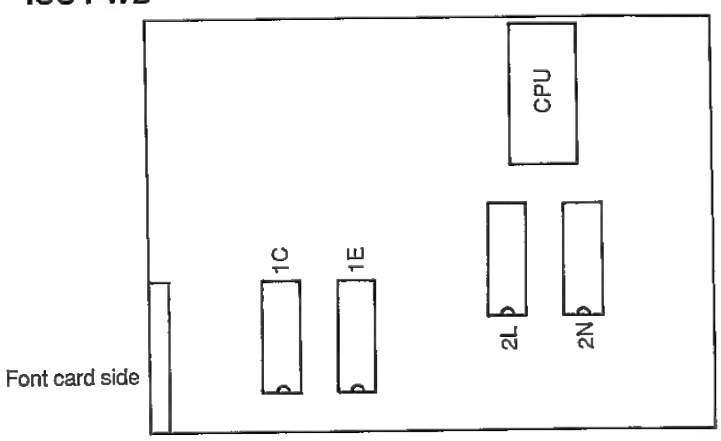
ID	HP	D630	FX80		IBM
41				DENMARK2-L	
42			ELITE 12	U.S.A.-P	
43			(ITALIC)	FRANCE-P	
44				GERMANY-P	
45				ENGLAND-P	
46				DENMARK-P	
47				SWEDEN-P	
48				ITALY-P	
49				SPAIN-P	
4A				JAPAN-P	
4B				NORWAY-P	
4C				DENMARK2-P	
4D			ELITE 12	U.S.A.-L	
4E			(ITALIC)	FRANCE-L	
2F				GERMANY-L	
50	— DOWN LOAD FONT —			ENGLAND-L	
51				DENMARK-L	
52				SWEDEN-L	
53				ITALY-L	
54				SPAIN-L	
55				JAPAN-L	
				NORWAY-L	
6F				DENMARK2-L	
70					
71	ADV.PATTERN #1				
72	ADV.PATTERN #2				
73	ADV.PATTERN #3				
74	ADV.PATTERN #4				
75	ADV.PATTERN #5				
76	ADV.PATTERN #6				
77	ADV.GRAYSCALE 1-2%				
78	ADV.GRAYSCALE 3-10%				
79	ADV.GRAYSCALE 11-20%				
7A	ADV.GRAYSCALE 21-40%				
7B	ADV.GRAYSCALE 41-60%				
7C	ADV.GRAYSCALE 61-80%				
7D	ADV.GRAYSCALE 81-99%				
7E	ADV.GRAYSCALE 100%				
7F					
100	— MACRO ID —				
11F					

10. ROM installing positions on ICU PWB

Note: A pair of either CG ROM"s or program ROM's is composed of two parts of the same version. Never mix different versions.

PARTS CODE	LOCATION	VERSION NO.	DESCRIPTION
VHi27256-23FC	1C	RCG1D	CG ROM
VHi27256-24FC	1E	RCG2D	CG ROM
VHi27512-26FC	2L	ICC1L	PROGRAM ROM
VHi27512-27FC	2N	ICC2L	PROGRAM ROM

ICU PWB



[15] Signal guide

GENERAL

For guidance in looking at the circuit diagram, this guide describes the symbols and simple notes for signal names appearing in the JX-9300 Service Manual circuit diagrams.

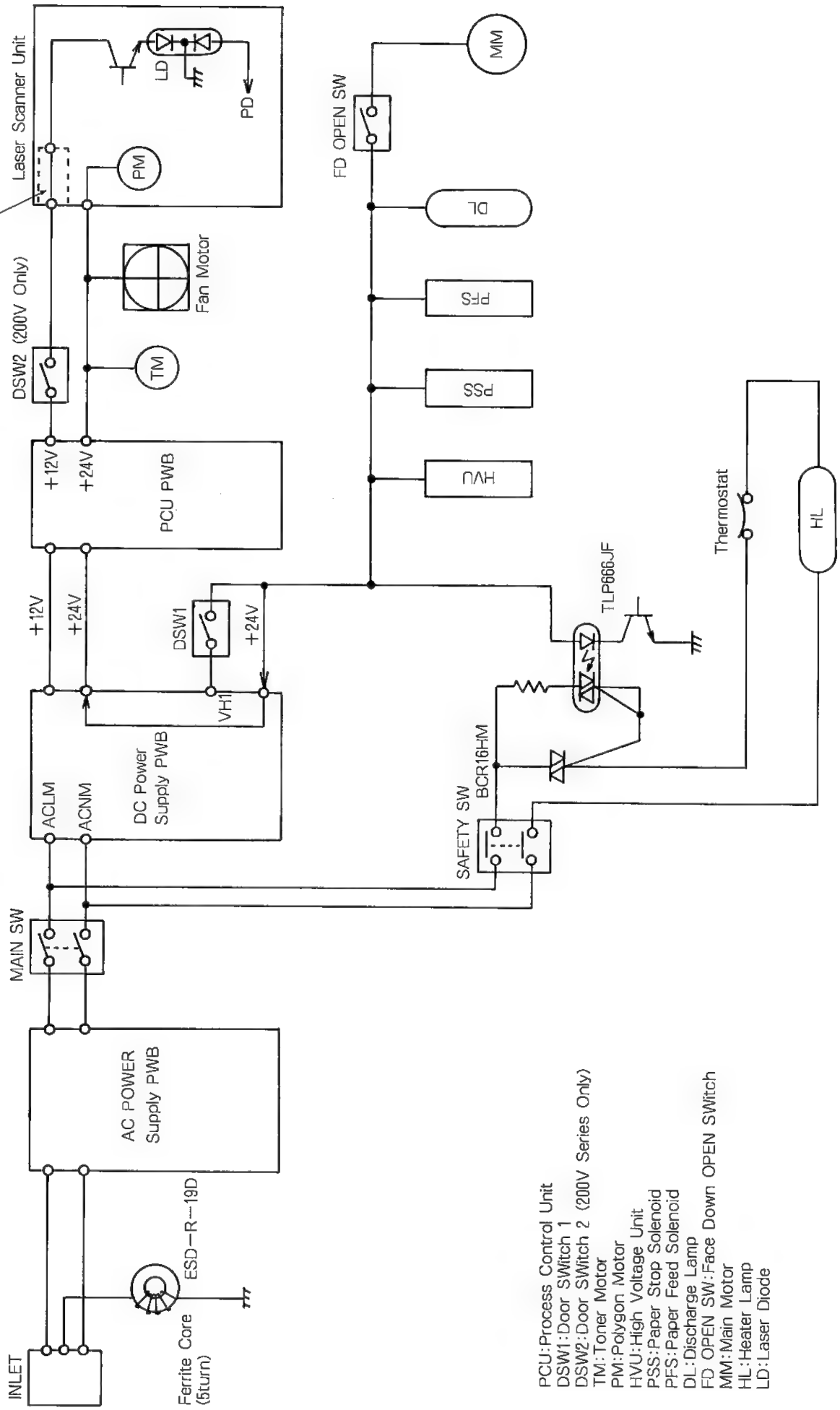
For more details, please refer to the service manual description.

Signal name		Term
APCEN	:	Auto Power Control Enable
BD	:	Beam Detect
BIASON	:	Bias ON
CE	:	Chip Enable
CENTCS	:	Centronics chip select
CGADR	:	CG Address
CGD	:	CG Data
CGEN	:	CG enable
CGLS	:	CG chip select
CGOE	:	CG OE
CGON	:	CG ON
CGRAS	:	CG RAS
CGRDY	:	CG Ready
CGRDY	:	CG Ready
CGWE	:	CG WE
CLK	:	Clock
CLK8	:	CLOCK 8 MHz
CLKN	:	Clock Negative
CMD	:	Command
CMIS	:	Cartridge Missing
CRFSH	:	CG Refresh
CYNC	:	Sync signal
DI0-3	:	Data Input 0-3
DLON	:	Discharge Lamp ON
DRAW	:	Draw signal
DS1-2	:	Data Select 1-2
DTACK	:	Data acknolige
FCDCS	:	Font card chip select
FDOUT	:	Face Down Out
FDOWN	:	Face Down
FM24	:	Fan Motor 24V
FMD	:	Fan Motor Drive
GRLON	:	Grid Low ON
HFIN	:	Hand Feed In
HLON	:	Heater Lamp ON
HSYNC	:	Horizontal Synchronization
HTH	:	Heater Lamp Temperature High
HTL	:	Heater Lamp Temperature Low
I/F INT	:	Interface interupt
IPCS	:	Image processor chip select
IRQ	:	Image requast
KI	:	Key Status Input
LD1-2	:	Load 1-2
LDABN	:	Laser Diode Abnormal
LDON	:	Laser Diode ON
LDS	:	Lower data strobe
LMCLK	:	Left Margin Clock
LMD0-3	:	Left Margin Data 0-3
LMOUT	:	Left Margin Output
MDL1-3	:	Module 1-3
MHVON	:	Main Corona High Voltage ON
MM24	:	Main Motor 24V
MMD	:	Main Motor Drive
MMTLK	:	Main Motor Lock
NMI	:	Non maskable interupt
OBTEN	:	Obtain enable
OSSTT	:	Optical System Start
PAGE	:	Page signal
PCUCS	:	PCU chip select
PDATA	:	PRINT DATA
PFSON	:	Paper Feed Solenoid ON
PG	:	Page signal
PIN	:	Paper In
PMD	:	Polygonal Motor Drive
PMTLK	:	Polygonal Motor Lock
POFF	:	Power Off
POR	:	Power on reset
POUT	:	Paper Out
PRDY	:	PCU Ready
PRIM	:	PRIME
PRIMIN	:	PRIME input
PRSTT	:	Print Start
PSSON	:	Paper Stop Solenoid ON
RA	:	Ring Butter address
RCAS	:	Ring Butter CAS
RD	:	Ring Butter Data
RES	:	Reset
RESIN	:	Reset in
RJDCS	:	Resident chip select
ROE	:	Ring Butter OE
RRAS	:	Ring Butter RAS
RSCS	:	RS232C chip select
RWE	:	Ring Butter WE
Rx	:	Receiver
SCK	:	Serial Clock
SIO	:	Serial Input/Output
STS	:	Status
T2	:	Timer 2
TE	:	Toner Empty
THO	:	Thermistor Open
THVON	:	Transfer Corona High Voltage ON
TIMCS	:	Timer chip select
TM1-2	:	Toner Motor 1-2
TOINT	:	Timer O interupt
TRIGG	:	Trigger
Tx	:	Transmitter
TxRx	:	Transmitter/Receiver
UDS	:	Upper data strobe
VIDEON	:	Video Negative
WT	:	Warm-up Temperature

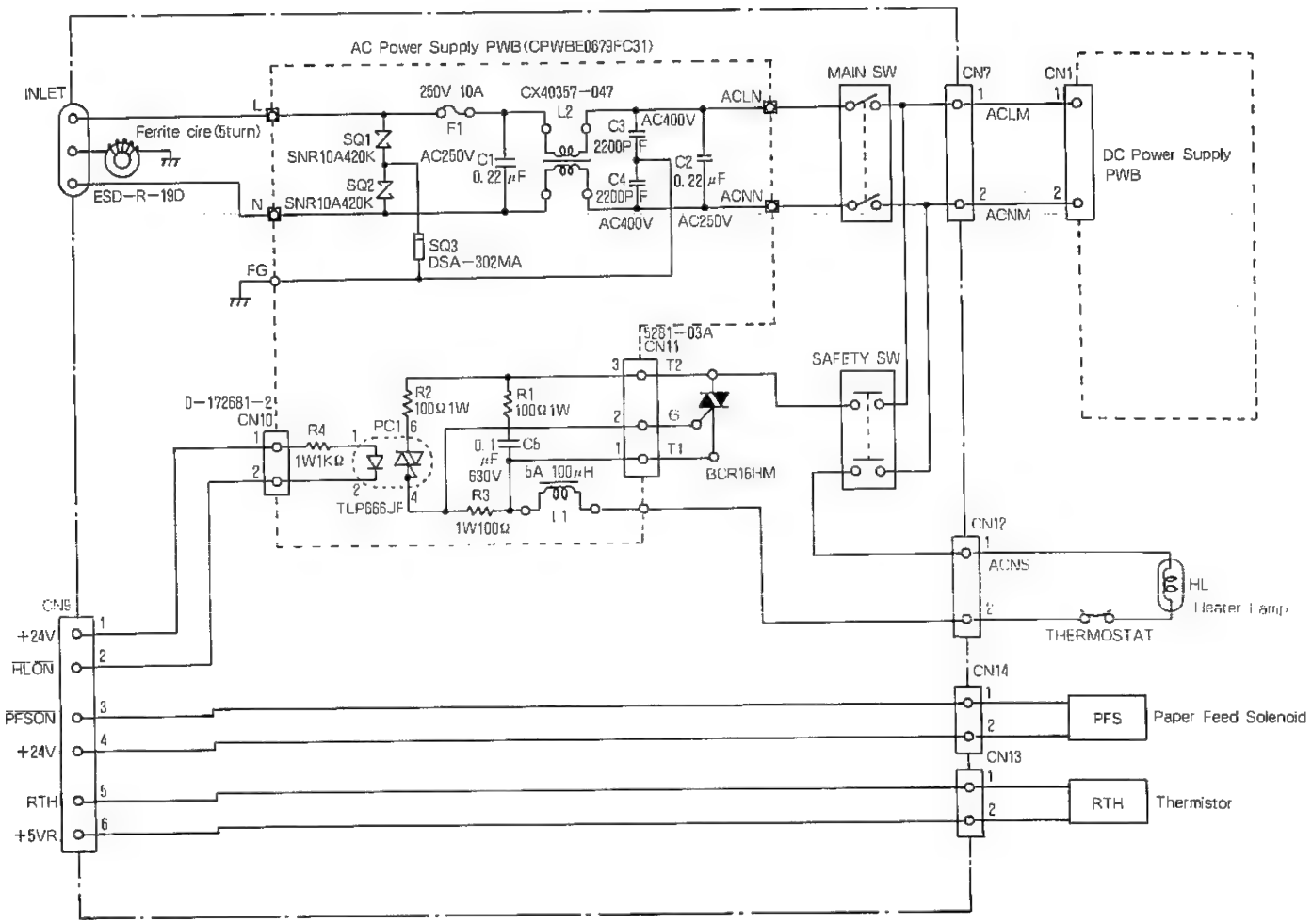
CIRCUIT DIAGRAM

CONTENTS

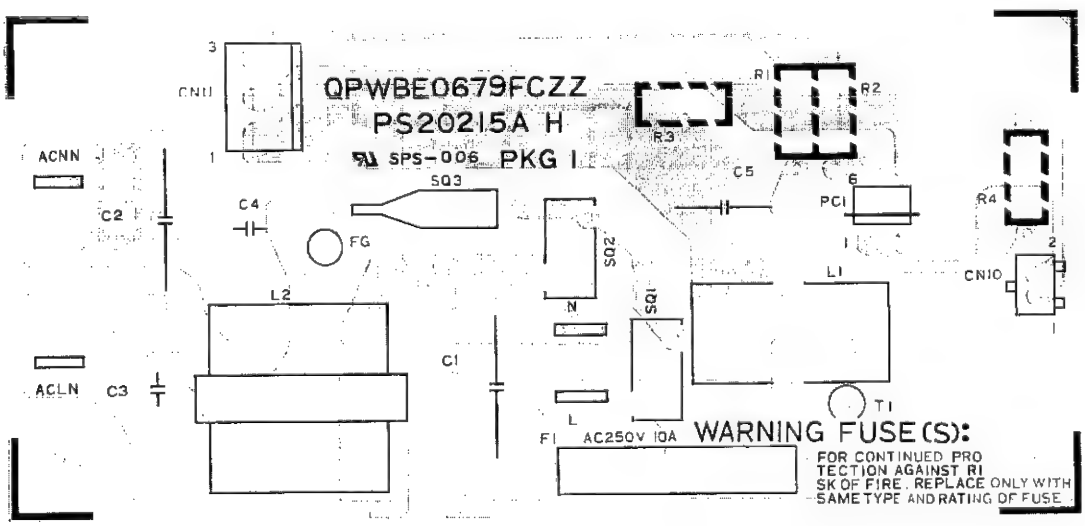
[1] INTER LOCK CIRCUIT)



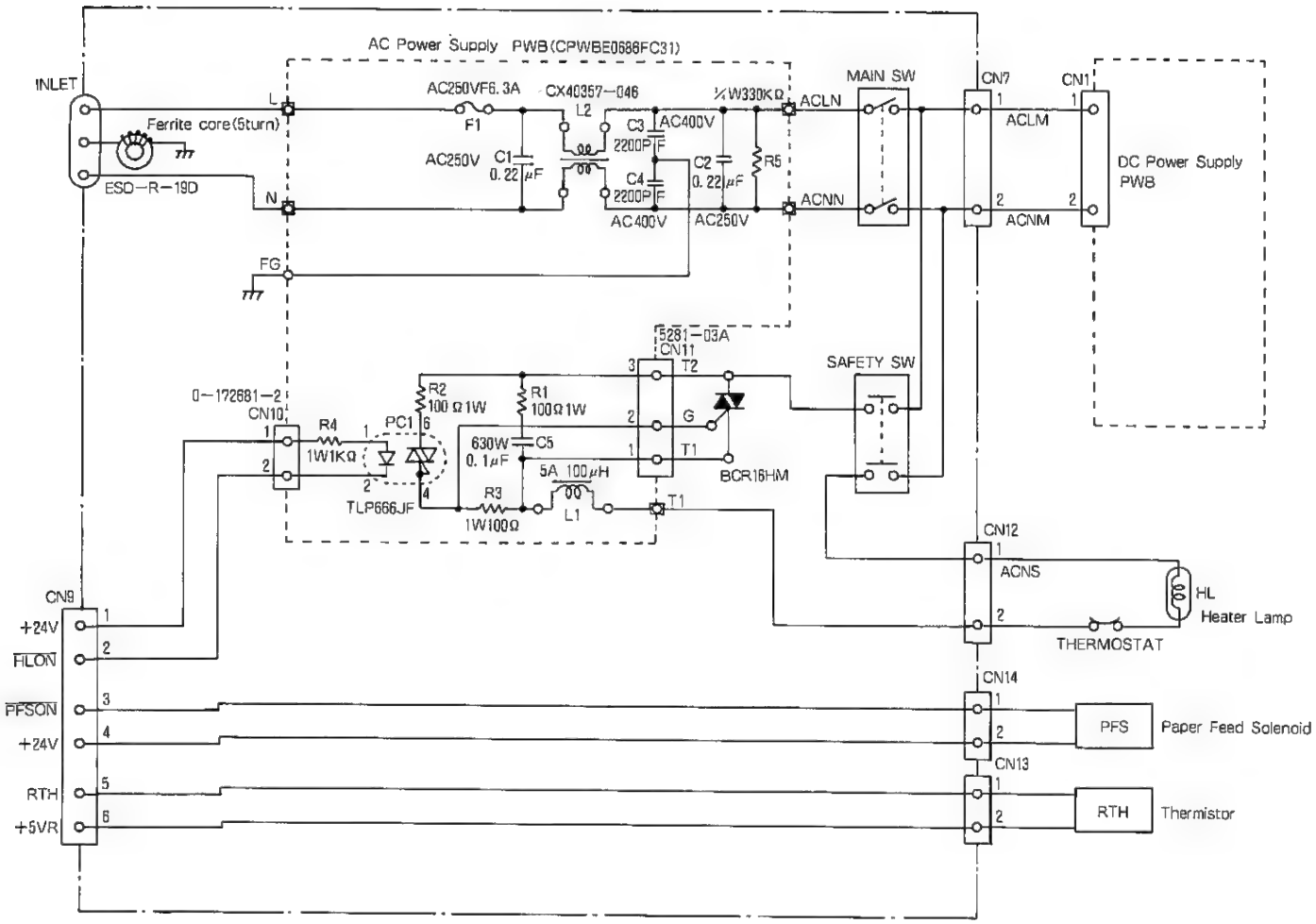
[2] AC POWER SUPPLY CIRCUIT (100V SERIES)



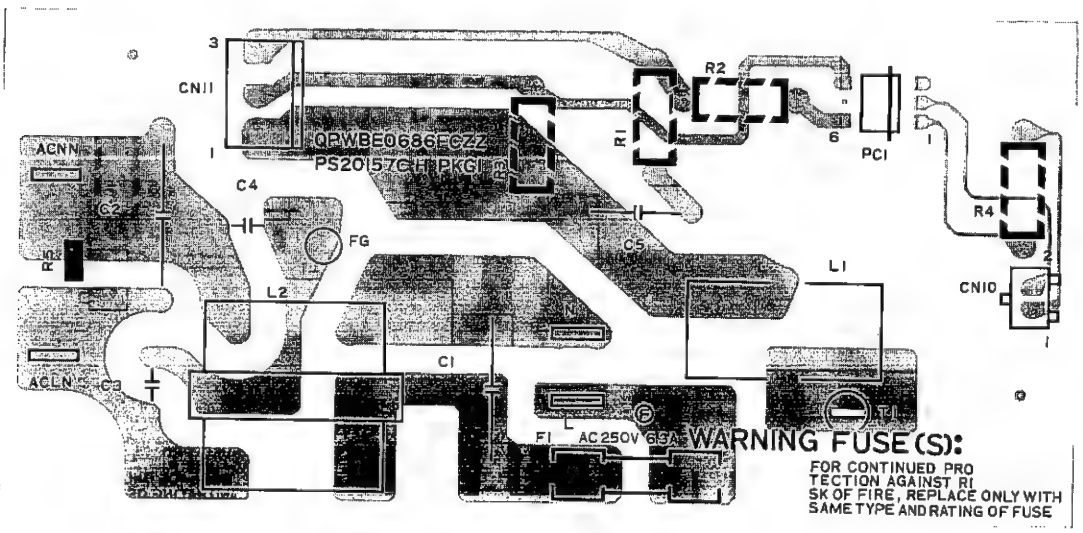
[2] AC POWER SUPPLY P.W.B. (100V SERIES)



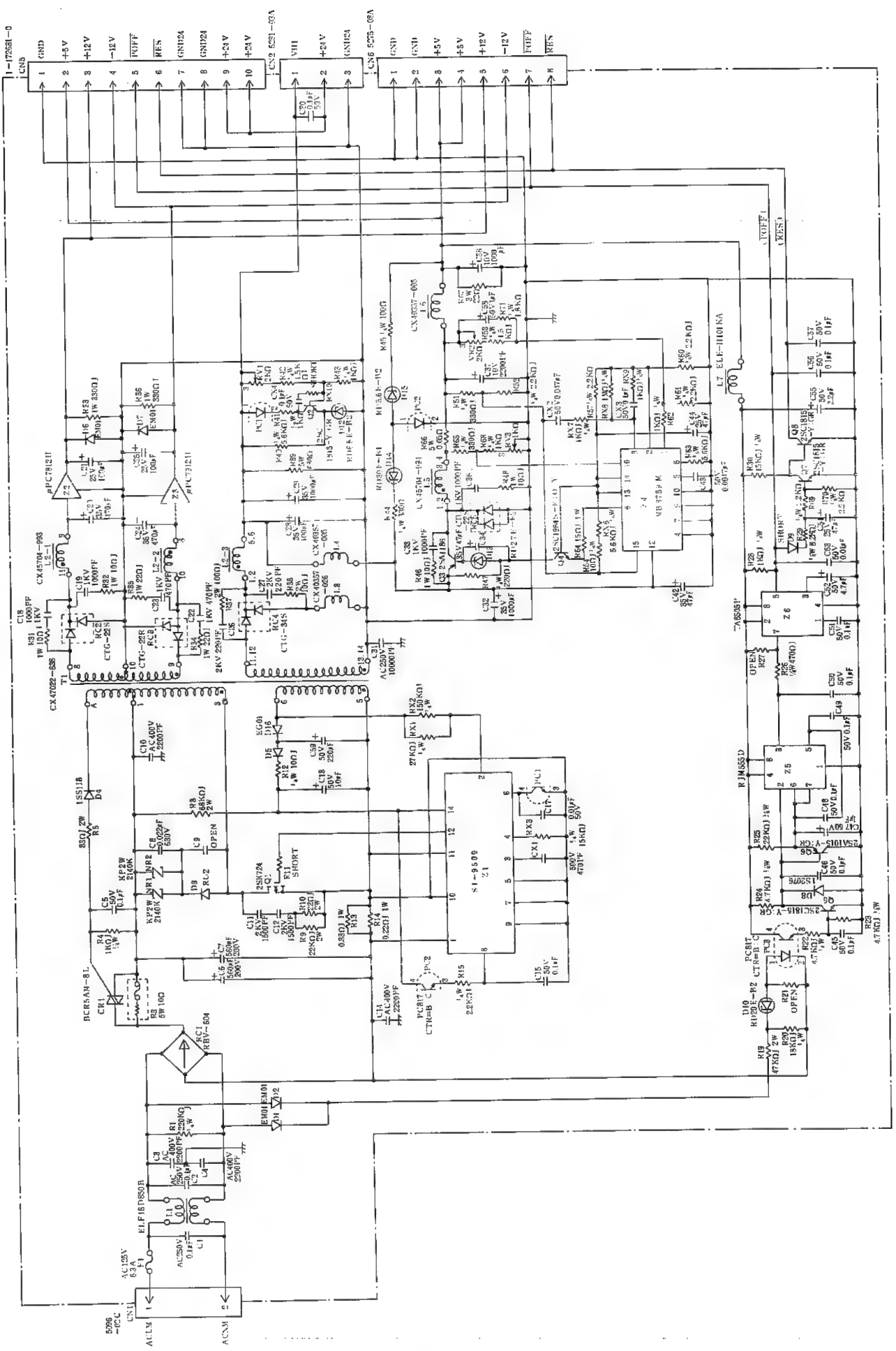
[2] AC POWER SUPPLY CIRCUIT (200V SERIES)



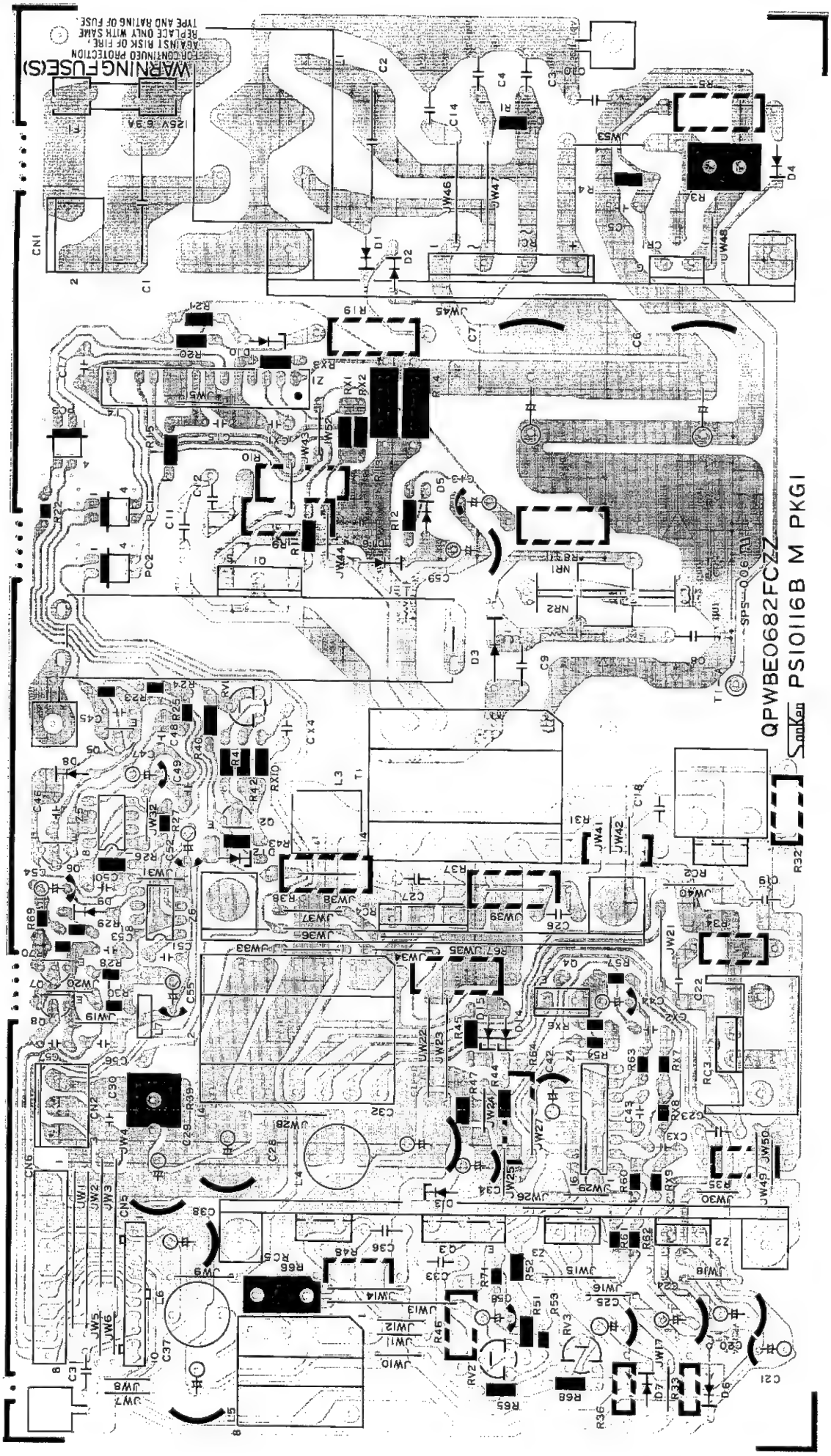
[2] AC POWER SUPPLY P.W.B. (200V SERIES)



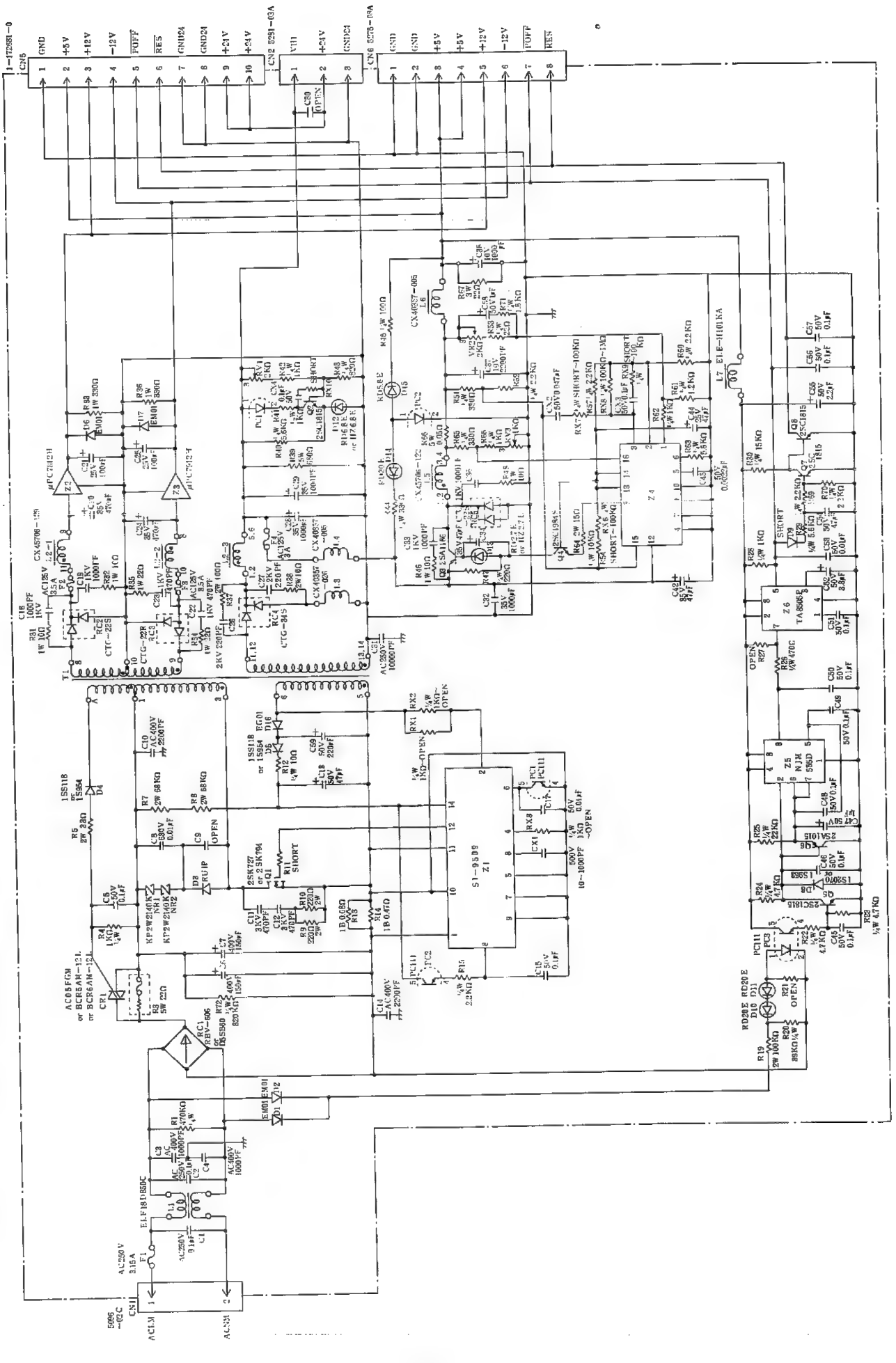
[3] DC POWER SUPPLY CIRCUIT (100V SERIES)



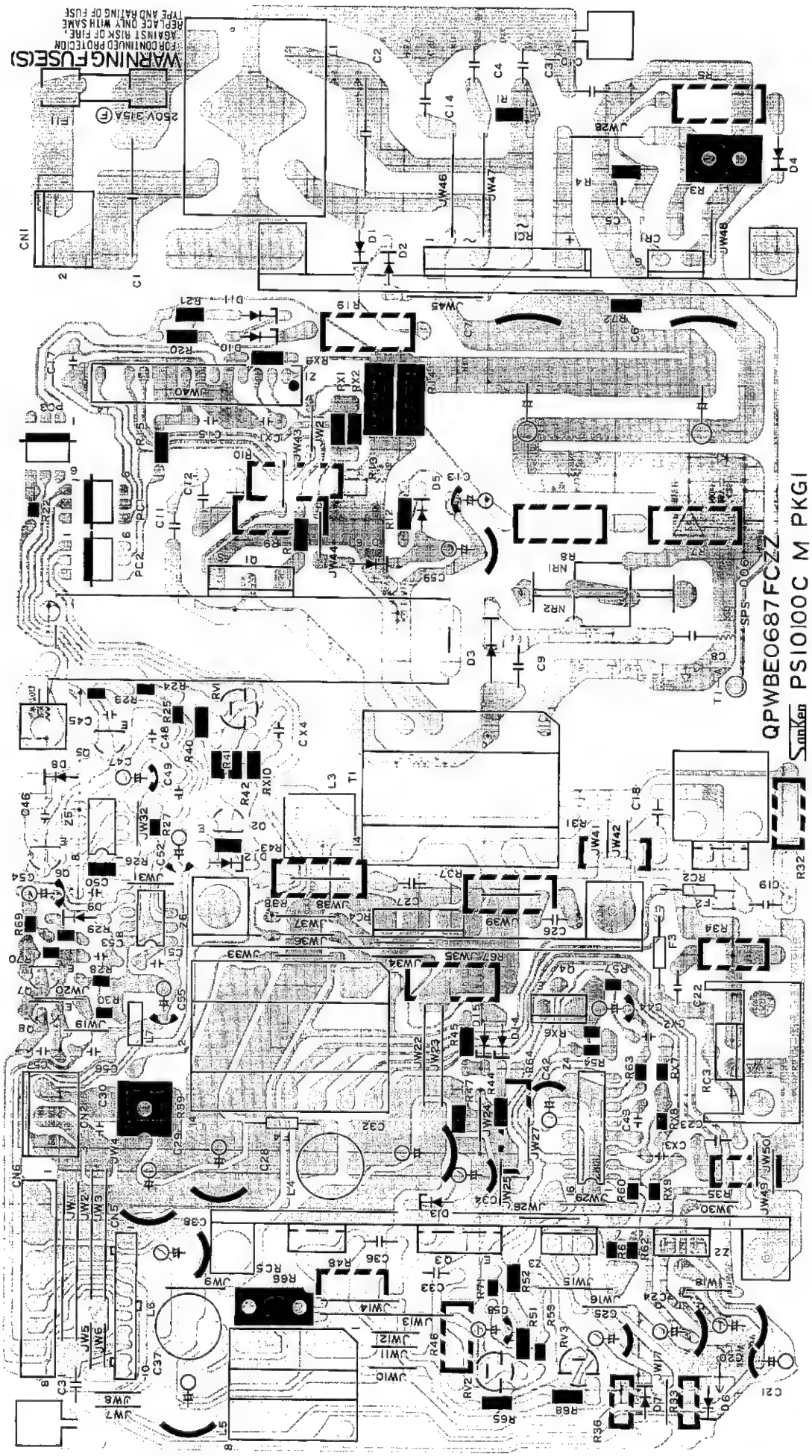
[3] DC POWER SUPPLY P.W.B (100V SERIER)



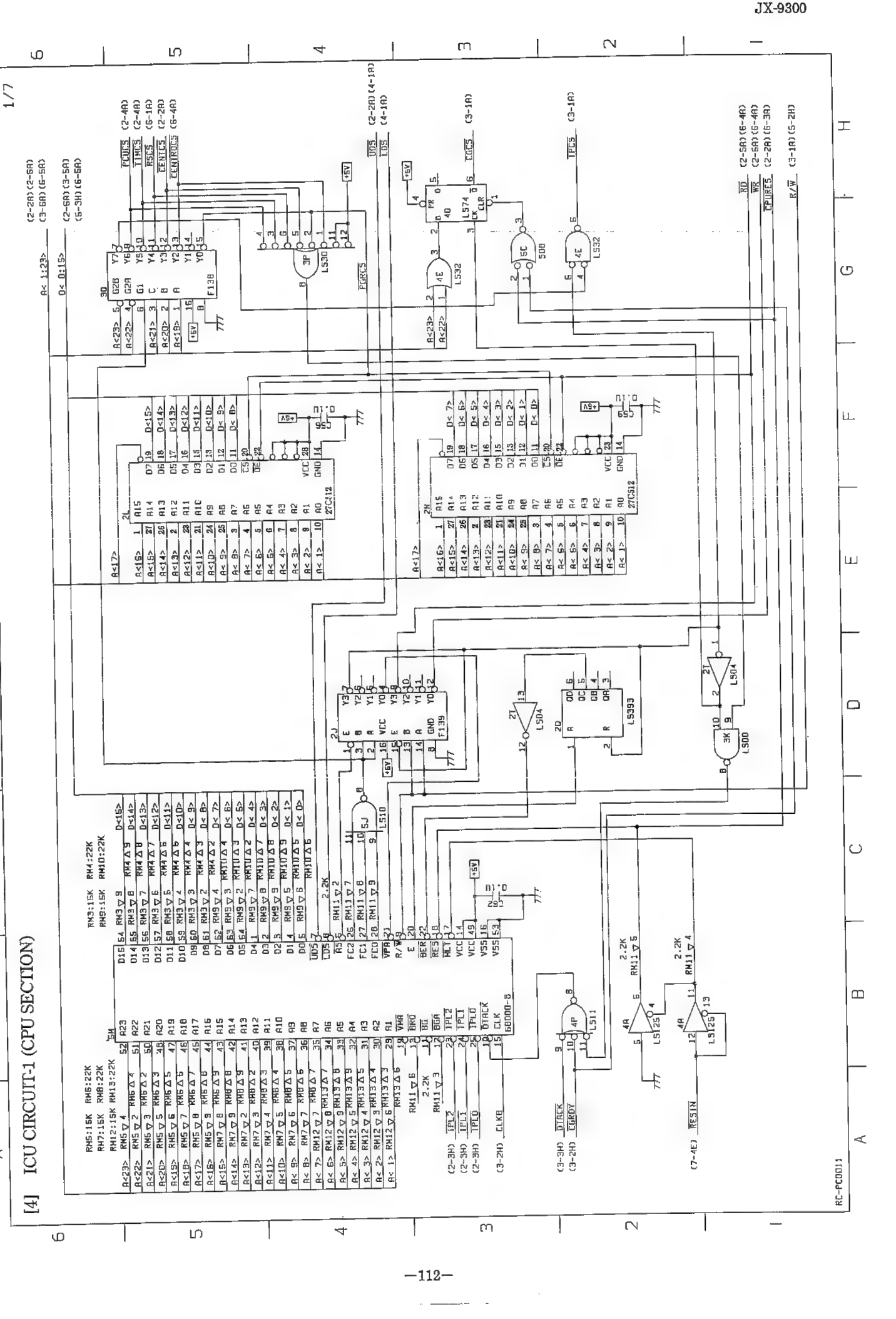
[3] DC POWER SUPPLY CIRCUIT (200V SERIES)

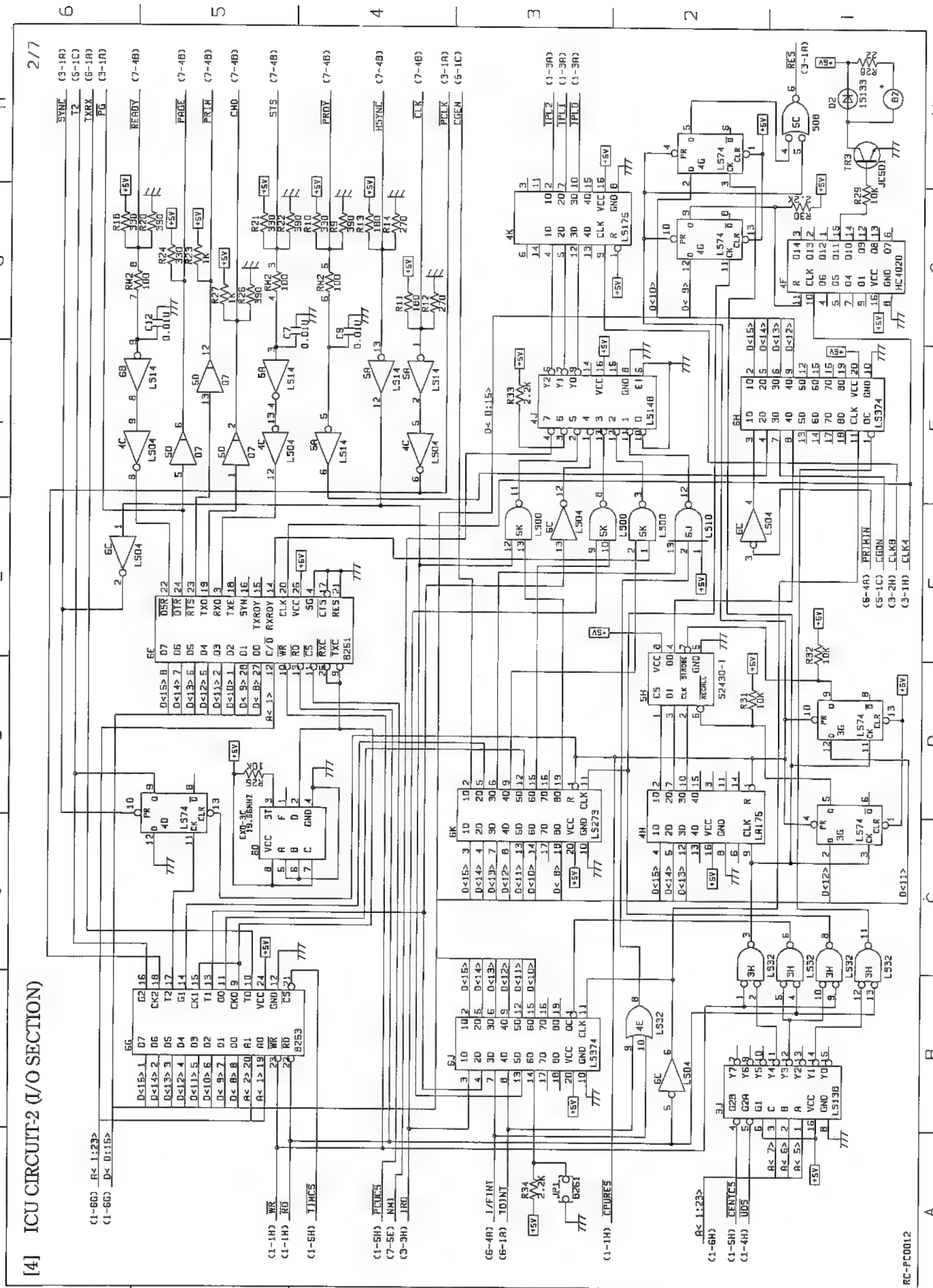


[3] DC POWER SUPPLY P.W.B (200V SERIES)

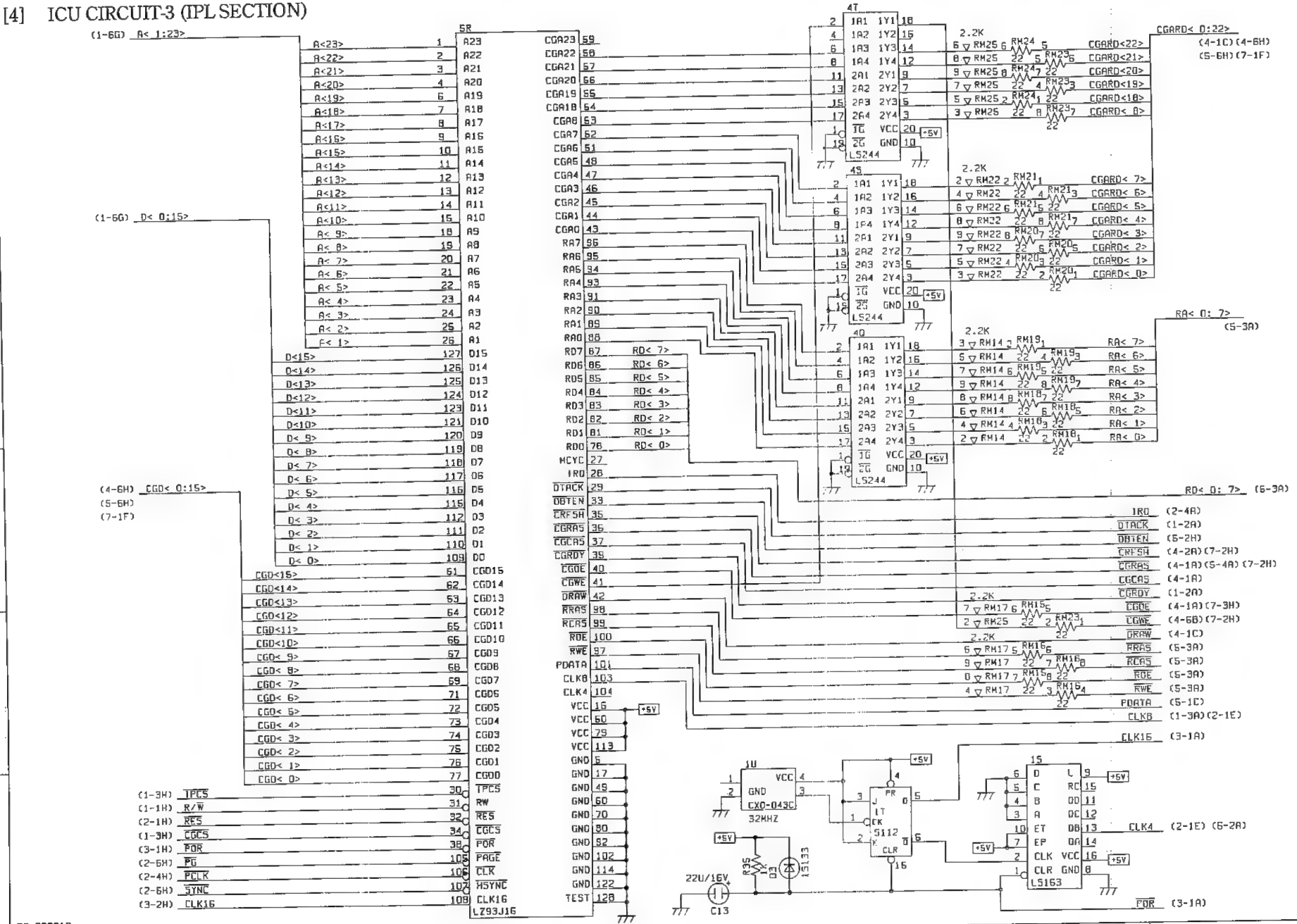


[4] ICU CIRCUIT-1 (CPU SECTION)

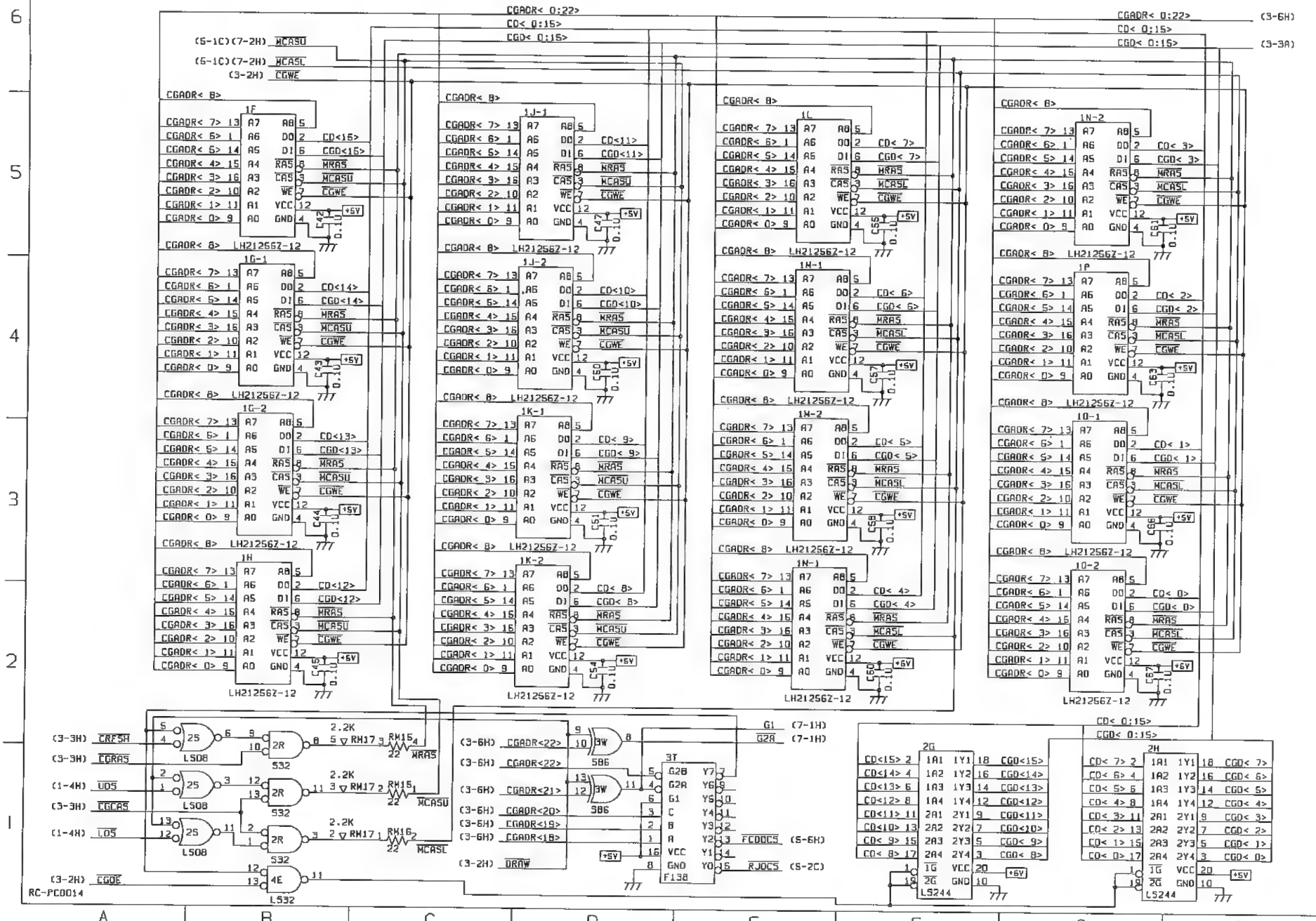



[4] ICU CIRCUIT-2 (I/O SECTION)
2/7
RC-PC0012

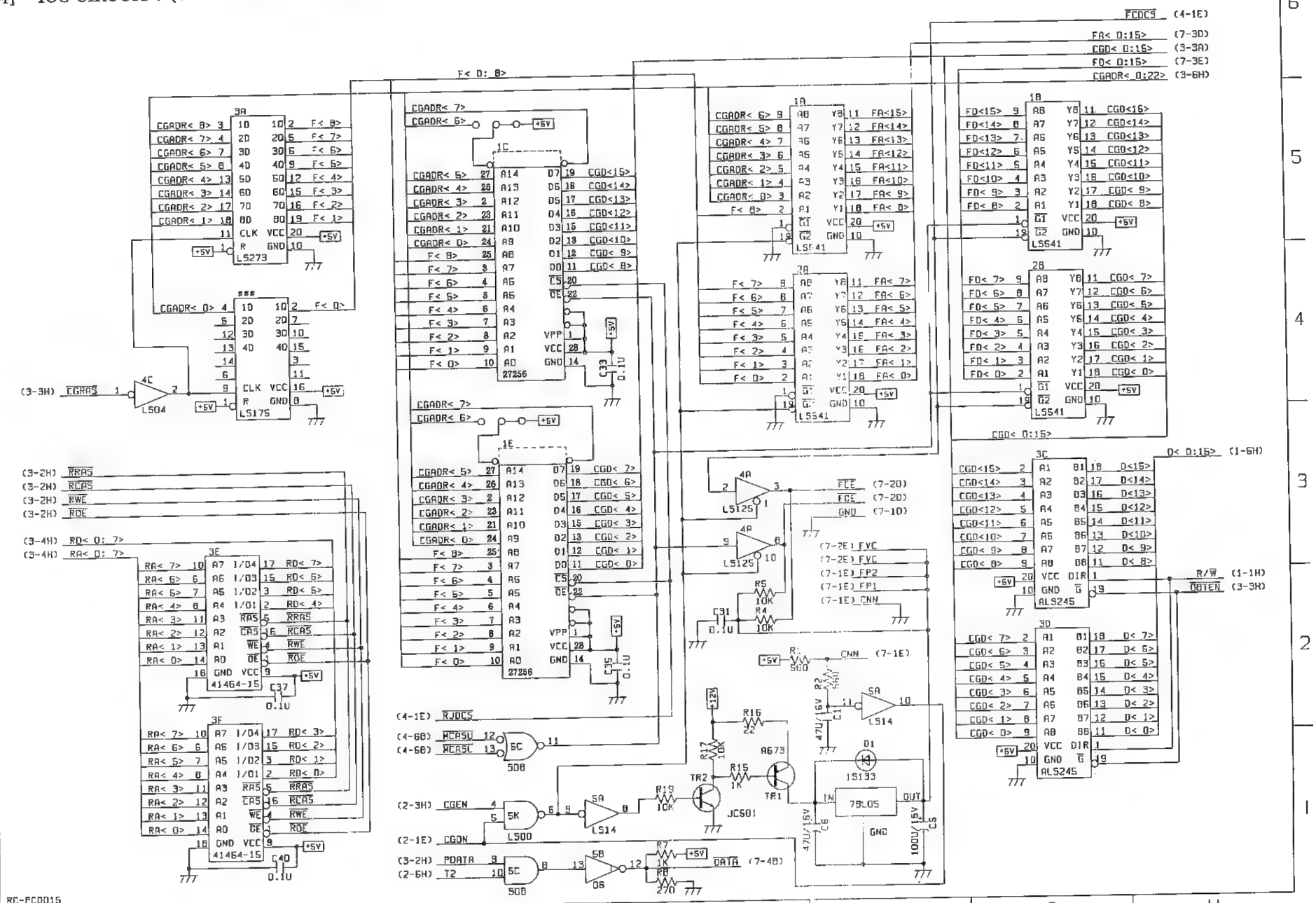
[4] ICU CIRCUIT-3 (IPL SECTION)



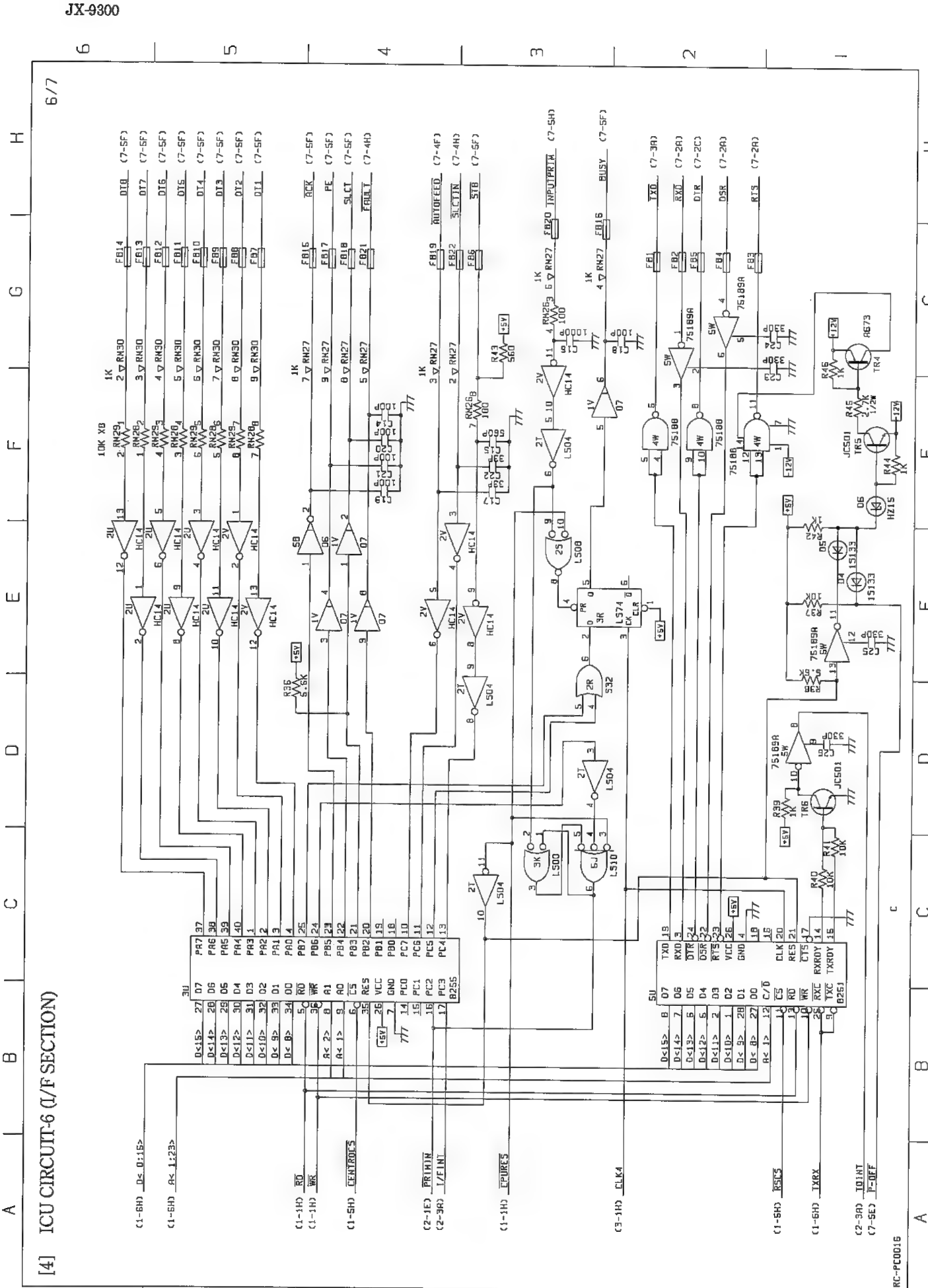
[4] ICU CIRCUIT-4 (USER RAM SECTION)



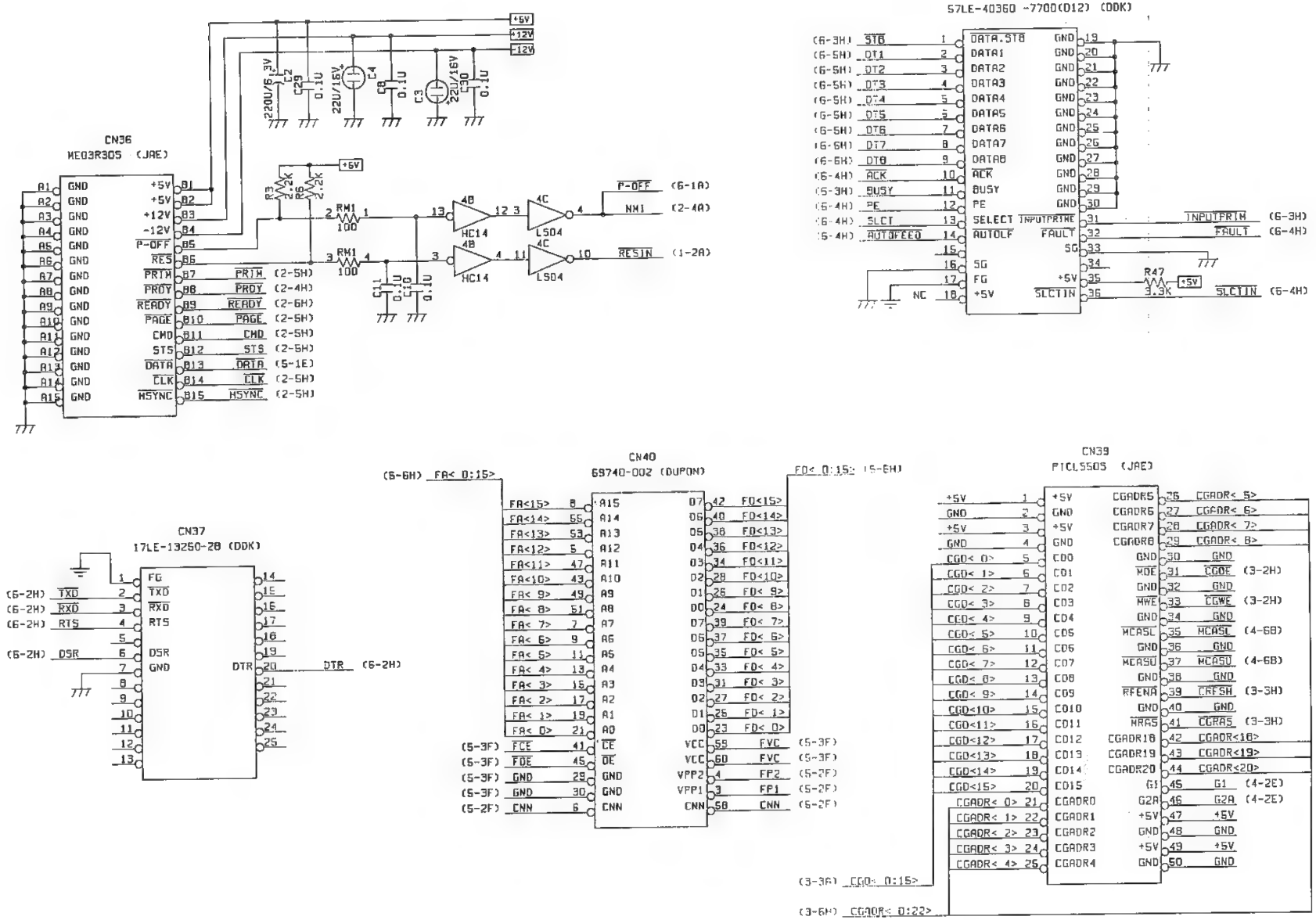
[4] ICU CIRCUIT-5 (CG MEMORY SECTION)



[4] ICU CIRCUIT-6 (I/F SECTION)

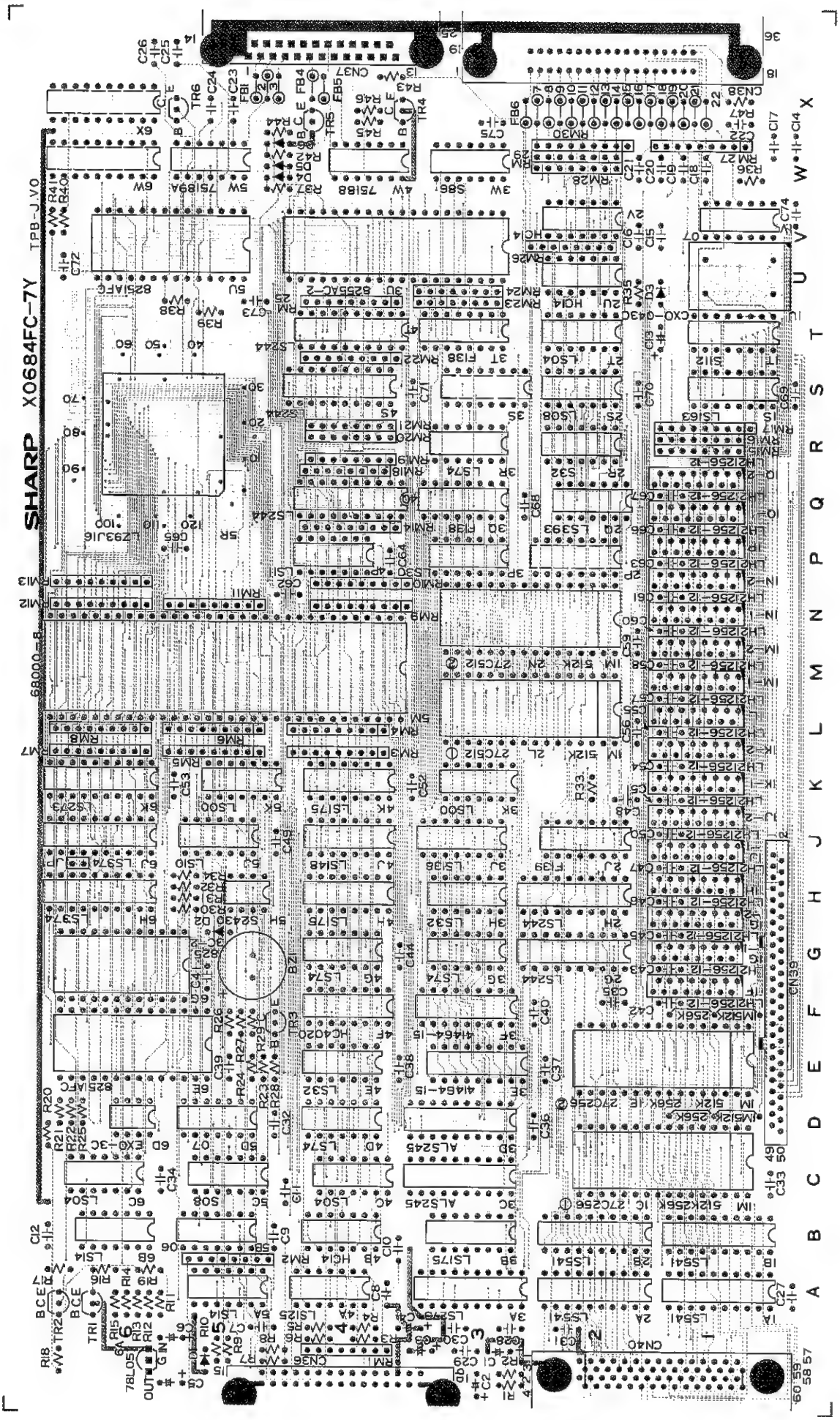


[4] ICU CIRCUIT-7 (CONECTOR SECTION)

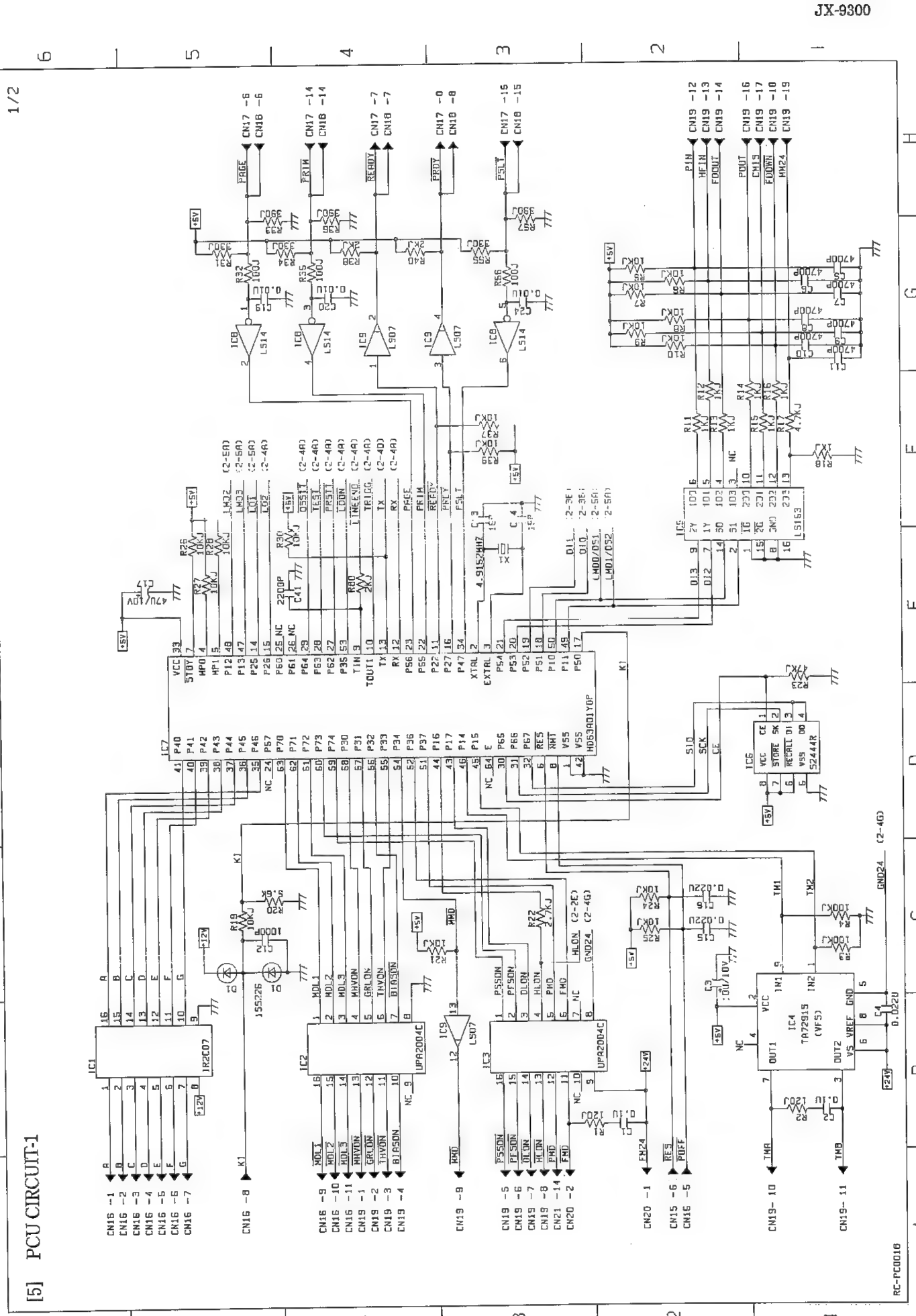


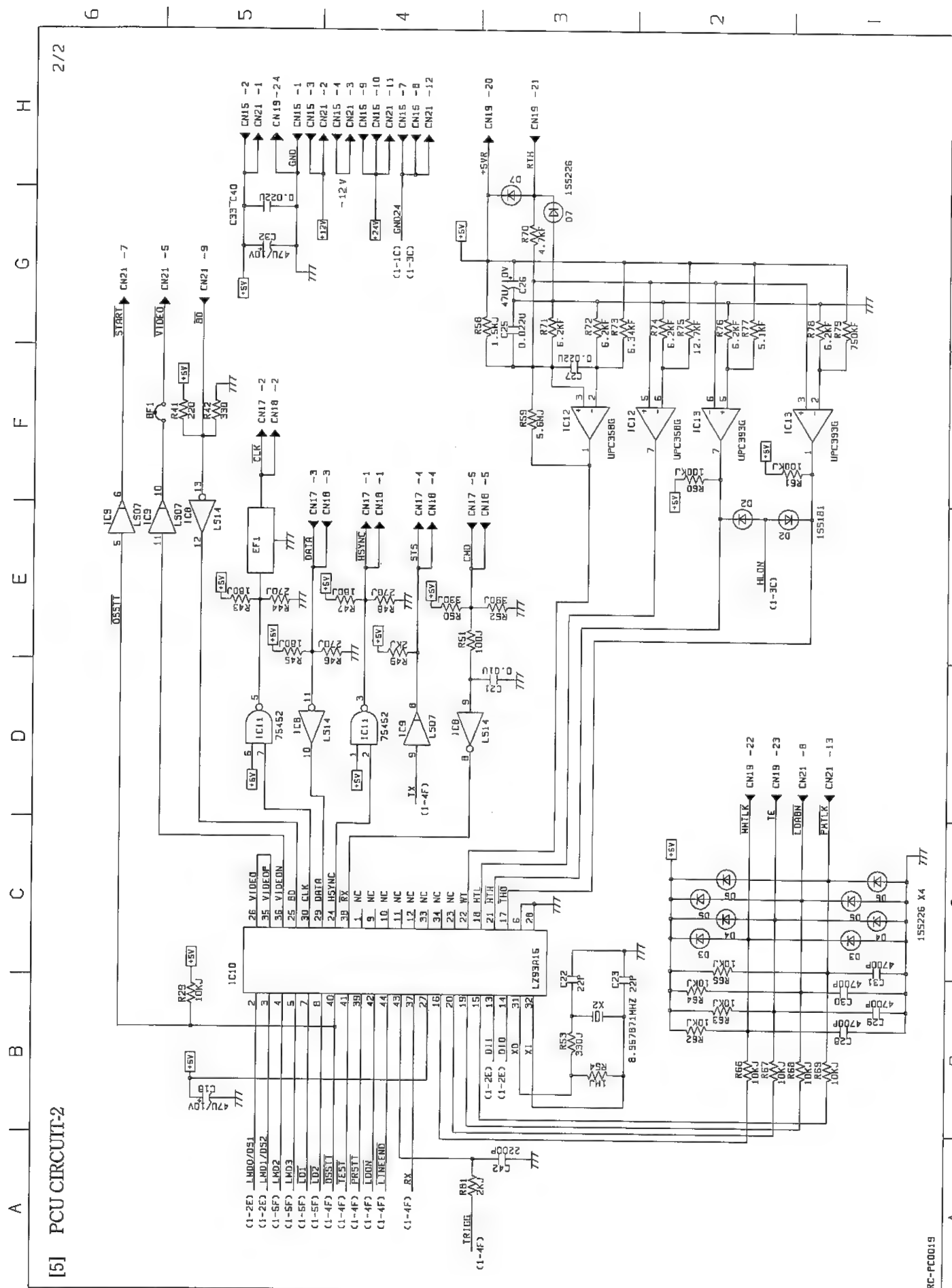
RC-PC0017

[4] ICU P.W.B

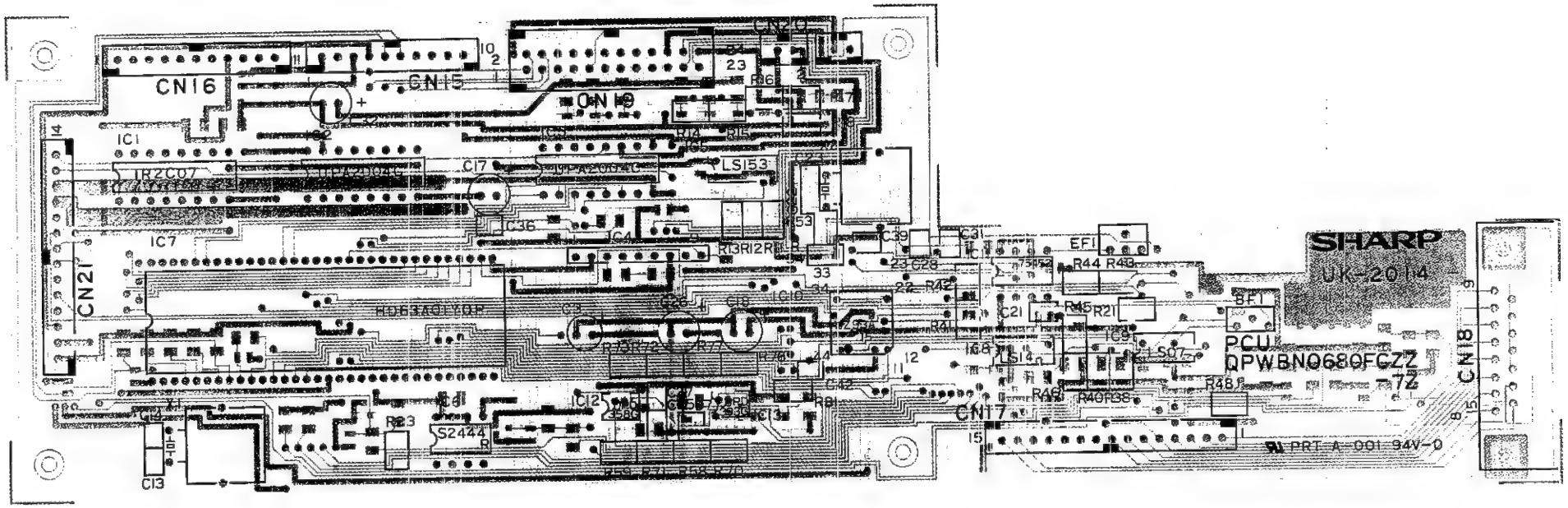


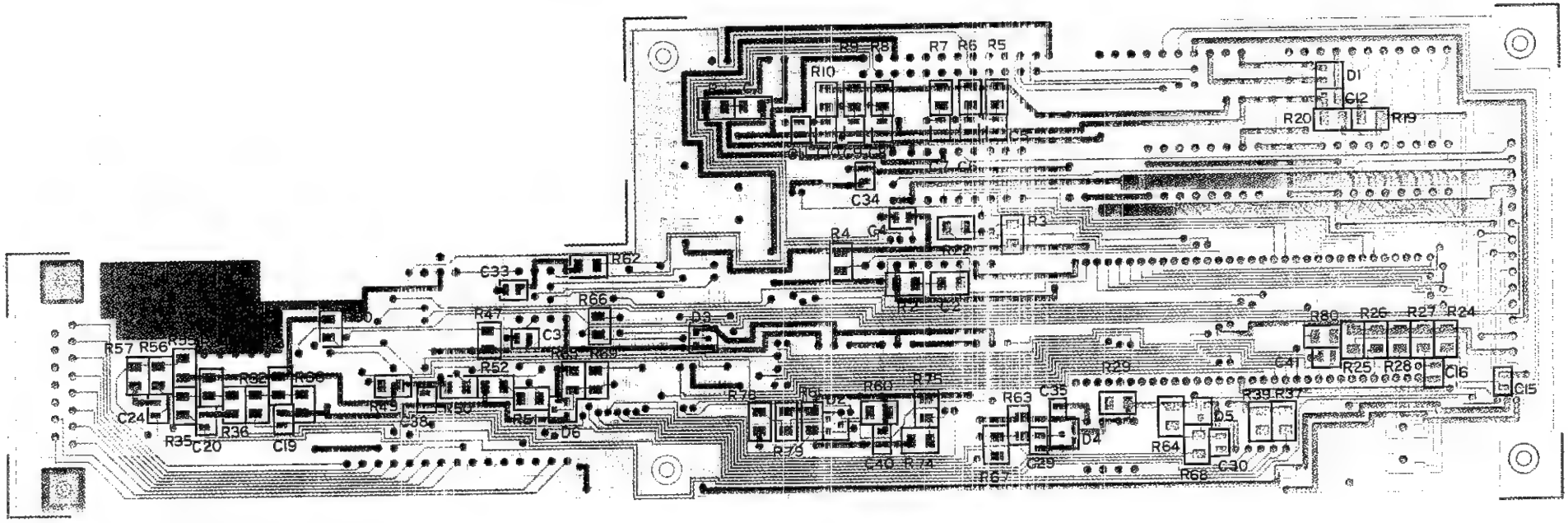
[5] PCU CIRCUIT-1



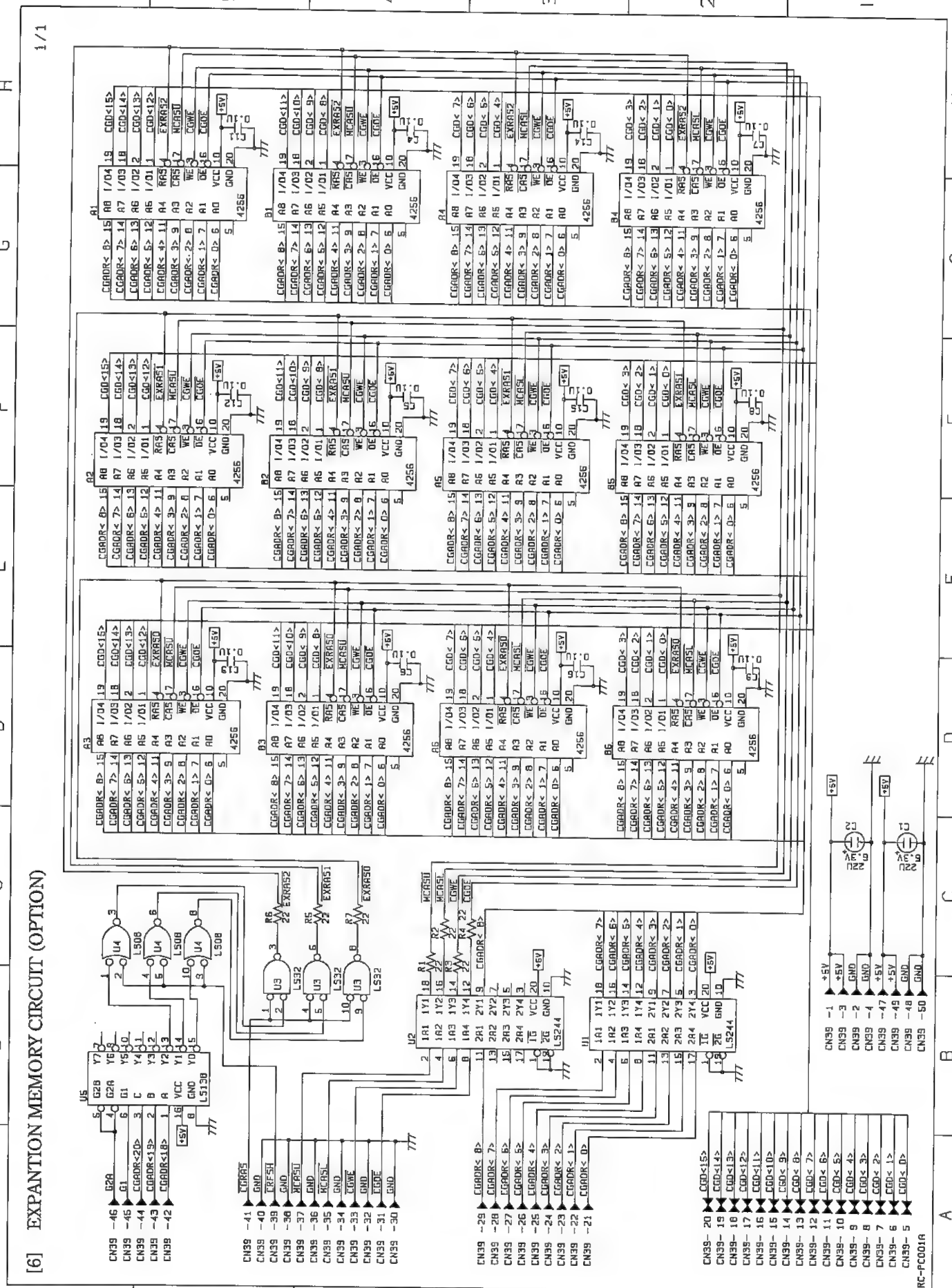

[5] PCU CIRCUIT-2
2/2
RC-PC0019
IC10
LZ93A15
8.95787MHz
155226 X4
UPC358G
UPC393G
75452
LS14
LS07
155181

[5] PCU P.W.B


CN16
CN15
CN14
CN13
CN12
CN21
CN17
CN18
IC1
IC2
IC4
IC7
IC9
IC10
IR2C07
TLP2004C
LS153
LS14
LS07
HD63A01Y0P
S2444
SHARP
UK-2014
PCU
QPWBN0680FCZZ
7Z
PRT A 001 94V-0


D1
D2
D3
D4
D5
D6
C12
C13
C15
C16
C19
C20
C24
C29
C30
C33
C34
C35
C40
C41
R19
R20
R24
R25
R26
R27
R28
R29
R35
R36
R39
R64
R68
R80

[6] EXPANTION MEMORY CIRCUIT (OPTION)



[7] CONNECTOR SIGNAL NAME

CN1	AC-IN
	5096-02C
1	ACLM
2	ACNM

CN2	DSW
	5281-03A
1	VH1
2	DSW (+24V)
3	GND24

CN3	FDSW
	SMR-02V-N
1	$\overline{\text{FDOWN}}$
2	GND

CN4	FD OUT SW
	SMP-02V-BC
1	FDOUT
2	GND

CN5	PCU
	1-172681-0
1	GND
2	+5V
3	+12V
4	-12V
5	$\overline{\text{POFF}}$
6	$\overline{\text{RES}}$
7	GND24 (For +24V)
8	GND24 (For +24V)
9	+24V
10	+24V

CN6	ICU
	5275-08A
1	GND
2	GND
3	+5V
4	+5V
5	+12V
6	-12V
7	$\overline{\text{POFF}}$
8	$\overline{\text{RES}}$

CN7	AC-OUT
	172328-1
1	ACLM
2	ACNM

CN8	FD OPEN SW
	SMR-02V-B
1	DSW (+24V)
2	MM24

CN9	UP-LOW
	51012-0600
1	+24V
2	$\overline{\text{HLON}}$
3	$\overline{\text{PFSON}}$
4	+24V
5	RTH
6	+5VR

CN10	TRIAC DRIVE
	172681-2
1	+24V
2	$\overline{\text{HLON}}$

CN11	TRIAC
	5281-03A
1	T_1
2	G
3	T_2

CN12	HL
	MLR-02
1	ACNS
2	HL

CN13	RTH
	51012-0200
1	RTH
2	+5VR

CN14	PFS
	51012-0201
1	$\overline{\text{PFSON}}$
2	+24V

CN15	PSU
	1-172681-0
1	GND
2	+5V
3	+12V
4	-12V
5	$\overline{\text{POFF}}$
6	$\overline{\text{RES}}$
7	GND24
8	GND24
9	+24V
10	+24V

CN16	OPU
	1-172681-1
1	A
2	B
3	C
4	D
5	E
6	F
7	G
8	KI
9	$\overline{\text{MDL1}}$
10	$\overline{\text{MDL2}}$
11	$\overline{\text{MDL3}}$

CN17 / CN16	ICU
	1-172681-5
	17LE-13150-28
1	$\overline{\text{HSYNC}}$
2	$\overline{\text{CLK}}$
3	$\overline{\text{DATA}}$
4	STS
5	CMD
6	$\overline{\text{PAGE}}$
7	$\overline{\text{READY}}$
8	$\overline{\text{PRDY}}$
9	GND
10	GND
11	GND
12	GND
13	GND
14	$\overline{\text{PRIM}}$
15	GND

CN19	MCU
	2-173052-6
1	$\overline{\text{MHVON}}$
2	$\overline{\text{GRLON}}$
3	$\overline{\text{THVON}}$
4	$\overline{\text{BIASON}}$
5	$\overline{\text{PSSON}}$
6	$\overline{\text{PFSON}}$
7	$\overline{\text{DLON}}$
8	$\overline{\text{HLON}}$
9	$\overline{\text{MMD}}$
10	TMA
11	TMB
12	PIN
13	HFIN
14	FDOUT
15	NC
16	POUT
17	CMIS
18	$\overline{\text{FDOWN}}$
19	MM24
20	+5VR
21	RTH
22	$\overline{\text{MMTLK}}$
23	TE
24	GND

CN20	FAN MOTOR
	172681-2
1	FM24
2	$\overline{\text{FMD}}$

CN21	LSU
	1-172681-4
1	+5V
2	+12V
3	-12V
4	GND
5	$\overline{\text{VIDEO}}$
6	VR
7	$\overline{\text{START}}$
8	$\overline{\text{LDABN}}$
9	BD
10	BR
11	+24V
12	GND24
13	$\overline{\text{PMTLK}}$
14	$\overline{\text{PMD}}$

C22	UPPER/LETYSWITCH
	MLP-02
1	VH1
2	DSW (+24V)

CN23	LDD PWS
	S14B-FH
1	+5V
2	+12V
3	-12V
4	GND
5	$\overline{\text{VIDEO}}$
6	VR
7	$\overline{\text{START}}$
8	$\overline{\text{LDABN}}$
9	$\overline{\text{BD}}$
10	BR

CN24	PMD PWB
	53015-0410
1	+24V
2	GND24V
3	$\overline{\text{PMTLK}}$
4	$\overline{\text{PMD}}$

CN25	POUT SW
	SMP-02V-NC
1	POUT
2	GND

CN26	PSS
	SMR-02V-B
1	PSSON
2	+24V

CN27	HVU
	172681-6
1	$\overline{\text{BIASON}}$
2	$\overline{\text{THVON}}$
3	$\overline{\text{MHVON}}$
4	$\overline{\text{GRLON}}$
5	GND24
6	+24V

CN28	MMC
	5484-04AX
1	$\overline{\text{MMTLK}}$
2	$\overline{\text{MMD}}$
3	+24V
4	GND24

CN29	TM, DV
	172168-1
1	+24V
2	TE
3	TMA
4	GND24
5	BS
6	TMB

CN30	DV
	52025-0411
1	+24V
2	TE
3	GND24
4	BS

CN31	PINSW
	51012-0400
1	PIN
2	GND
3	HFIN
4	GND

CN32	DL
	172681-2
1	$\overline{\text{DLON}}$
2	+24V

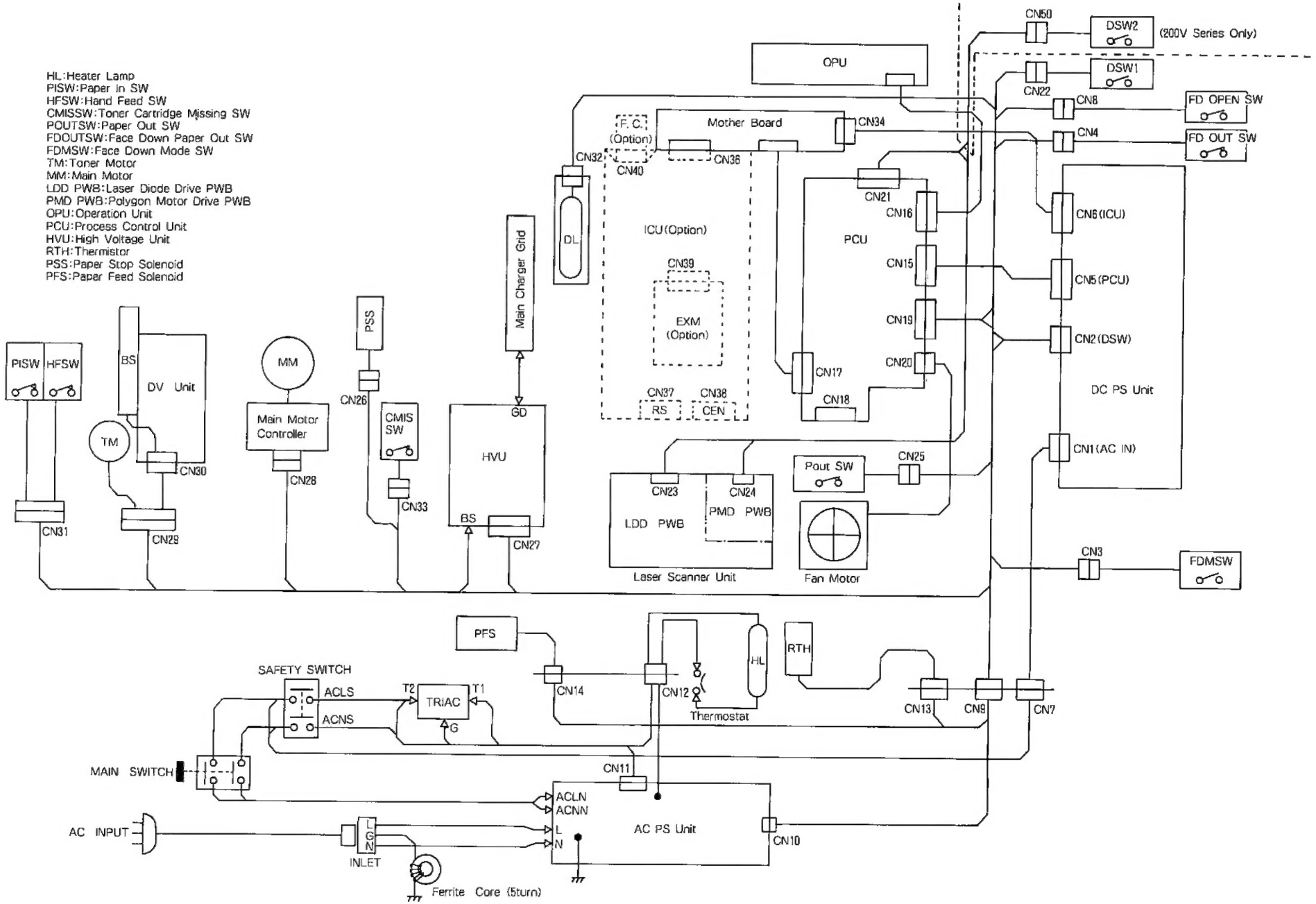
CN33	CMISSW
	SMP-02V-NC
1	CMIS
2	GND

CN34	PSU
1	GND
2	GND
3	+5V
4	+5V
5	+12V
6	-12V
7	$\overline{\text{POFF}}$
8	$\overline{\text{RES}}$

CN35	PCU
1	$\overline{\text{HSYNC}}$
2	$\overline{\text{CLK}}$
3	$\overline{\text{DATA}}$
4	STS
5	CMD
6	$\overline{\text{PAGE}}$
7	$\overline{\text{READY}}$
8	$\overline{\text{PRDY}}$
9	GND
10	GND
11	GND
12	GND
13	GND
14	$\overline{\text{PRIM}}$
15	$\overline{\text{PSLT}}$

CN36	ICU
1A	GND
1B	+5V
2A	GND
2B	+5V
3A	GND
3B	+12V
4A	GND
4B	-12V
5A	GND
5B	$\overline{\text{POFF}}$
6A	GND
6B	$\overline{\text{RES}}$
7A	GND
7B	$\overline{\text{PRIM}}$
8A	GND
8B	$\overline{\text{PRDY}}$
9A	GND
9B	$\overline{\text{READY}}$
10A	GND
10B	$\overline{\text{PAGE}}$
11A	GND
11B	CMD
12A	GND
12B	STS
13A	GND
13B	$\overline{\text{DATA}}$
14A	GND
14B	$\overline{\text{CLK}}$
15A	GND
15B	$\overline{\text{HSYNC}}$

[8] WIRING DIAGRAM



SHARP

SHARP CORPORATION
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Quality & Reliability Control Center
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